

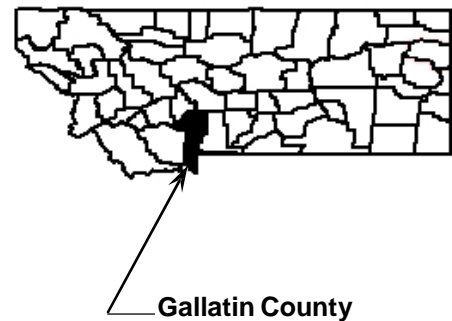
FLOOD INSURANCE STUDY



GALLATIN COUNTY, MONTANA AND INCORPORATED AREAS VOLUME 1 OF 3

| Community Name | Community Number |
|-----------------------------|------------------|
| * BELGRADE, CITY OF | 300105 |
| BOZEMAN, CITY OF | 300028 |
| GALLATIN COUNTY | |
| UNINCORPORATED AREAS | 300027 |
| * MANHATTAN, TOWN OF | 300034 |
| THREE FORKS, CITY OF | 300029 |
| * WEST YELLOWSTONE, TOWN OF | 300135 |

* NON-FLOOD PRONE COMMUNITY



PRELIMINARY DATE:
November 28, 2016



Federal Emergency Management Agency
Flood Insurance Study Number
30031CV001B

**NOTICE TO
FLOOD INSURANCE STUDY USERS**

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

| <u>Old Zone</u> | <u>New Zone</u> |
|-----------------|-----------------|
| A1 through A30 | AE |
| B | X |
| C | X |

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance Study components.

Initial Countywide FIS effective date: September 2, 2011

Revised FIS Dates: Xxxxx xx, 20xxx

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PUBLISHED SEPARATELY

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY GALLATIN COUNTY, MONTANA AND INCORPORATED AREAS

1.0 **INTRODUCTION**

1.1 Purpose Of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Gallatin County, Montana, including the Cities of Belgrade, Bozeman and Three Forks; the Towns of Manhattan, and West Yellowstone; as well as the remaining unincorporated area (referred to collectively herein as Gallatin County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Belgrade, and the Towns of Manhattan, and West Yellowstone are non-flood prone.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the 2011 countywide FIS (Reference 1) was prepared by first utilizing data from the effective FIS reports for the City of Three Forks, the City of Bozeman, and the unincorporated areas of Gallatin County (Reference 2, 3 and 4). More recent data has also been incorporated from several sources: 1) two studies by Anderson Engineers, Inc. (Anderson), the study of the East Gallatin River (Reference 5), and the East Gallatin River and Bridger Creek Flood Insurance Re-Study (Reference 6); 2) data concerning the City of Three Forks area provided by David Smith and Associates (DSA) (Reference 7) and Van Mullen Engineers (VME)(Reference 8). Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously submitted FISs or the new studies listed above are presented in Figure 1, "Study and Stream Identification Map" and are described below:

City of Three Forks The hydrologic and hydraulic analyses for the original study were performed by the NRCS, for the Federal Insurance Administration, (FIA) under Inter-Agency Agreement No. IAA-H-9-76, Project Order No. 16. This work was completed in February 1979.

A re-study hydrologic and hydraulic analysis along with an ice jam analysis was performed by VME for FEMA in May 2003 and revised in May 2004.

A LOMR, case # 05-08-A579P, was completed to complete Base Map Changes, update Hydraulic analysis, and incorporate new topographic data. This LOMR went effective on June 29, 2006.

Gallatin County (Unincorporated Areas)

The hydrologic and hydraulic analyses for the original study were performed by the NRCS, for FEMA, under Inter-Agency Agreement No. IAA- H-9-76, Project Order No. 16. This work was completed in September 1979.

The City of Belgrade did not previously have an FIS or FIRMs published.

This Flood Insurance Study report revises and updates information on the existence and severity of flood hazards in the geographical area of the unincorporated area of Gallatin County along the West Gallatin River and tributaries. For the Bozeman River and its tributaries, multiple contractors were involved in the delivery of the many components that comprise the project. Allied Engineering Services, Inc. (Allied) completed the field surveying tasks for all flooding sources in the project area (Reference 9). The Allied tasks included the collection of cross-section survey data and hydraulic structure data. The topographic data collection was provided by a joint venture between Photo Science, Inc. and Gaston Engineering & Surveying (Reference 10). Respec Consulting & Services (Respec) completed the hydrologic analyses for the 6 main basins in the Bozeman Creek watershed (HUC 12 100200080905) (References 11 to 16) the work was completed April 2014.

1.3 Coordination

For this revision, the initial CCO meeting was held on TBDxxxx, and attended by representatives of FEMA, Study Contractor COMPASS, community officials, and the State NFIP Coordinator.

The final CCO meeting was held on TBDxxxx to review and accept the results of this FIS. Those who attended this meeting included representatives of TBDxxxx, the Study Contractor, FEMA, and the communities. All problems raised at that meeting have been addressed in this study.

The initial Consultation Coordination Officer (CCO) meetings were held with representatives from the communities, the State of Montana, the study contractors, the NRCS, and FEMA, to explain the nature and purpose of FISs, and to identify the streams to be studied by detailed methods. All affected communities were requested to provide any data pertinent to the study. The final CCO meetings were held with representatives from the communities, the study contractors, the state of Montana, and FEMA to review the results of the studies. The dates for all these meetings are listed on Table 1, "Initial and Final CCO Meeting Dates".

Table 1. Initial and Final CCO Meeting Dates

| <u>Community Name</u> | <u>Initial CCO Meeting Date</u> | <u>Final CCO Meeting Date</u> |
|---|--|--|
| City of Bozeman | November 5-6, 1975 April 13, 1984 * | February 2, 1981 July 16, 1987 * |
| City of Three Forks | November 6, 1975 | September 11, 1979 |
| Gallatin County (Unincorporated Areas) | November 6, 1975 May 28, 1991 March 1995 May 30, 2001 | January 28, 1982 NA NA November 7, 2002 |

* Dates not available for the 2007 Anderson study.

The 2002 and 2007 Anderson studies were coordinated through the Gallatin County Planning Department and the MDNRC.

For the 2011 countywide FIS the final CCO meeting was held on January 13, 2010 to review the results of the countywide FIS.

2.0 **AREA STUDIED**

2.1 Scope of Study

This FIS report covers the geographic area of Gallatin County, Montana, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 2003 for the unincorporated areas of Gallatin County and the City of Three Forks, and through 1990 for City of Bozeman.

All, or portions of, the flooding sources listed in Table 2, "Detailed Studied Streams", were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the Flood Insurance Rate Maps (FIRMs).

Table 2. Detailed Studied Streams

| | |
|-----------------------------------|--------------------------|
| 3rd Avenue – Kagy Boulevard Split | Golf Course Split |
| Baker Creek | I90 Diversion |
| Baker Creek (Area) Overflow | I90 Lateral |
| Baker Creek West Overflow | Interstate 90 Split |
| Black Avenue Split | Jefferson River |
| Bozeman Creek | Kagy Rouse Split |
| Bridger Creek | Linney Road Split |
| Buster Gulch | Lower Black Avenue Split |
| Camp Creek | Madison River |
| Cedar Street Split | Mathew-Bird Creek |
| Church Avenue Split | Mill Ditch Diversion |
| East Gallatin River | Museum Split |

Table 2. Detailed Studied Streams

| | |
|--|-----------------------------|
| East Gallatin River Golf Course Reach | Moreland Ditch |
| East Gallatin River Overflow Reach | Nash Road Split |
| East Gallatin River Spillway Reach | Nash-Spring Creek |
| East Gallatin River Springhill Reach | Rain Roper Split |
| Figgins Creek | Rouse Avenue Split |
| Flat Creek | Sourdough Trail Split |
| Flat Creek – East Kagy Boulevard Split | Tracy Avenue Split |
| Gallagator Split | West Gallatin River |
| Garfield Street Split | West Gallatin East Overflow |

For this countywide FIS, limits of detailed study for the newly studied or revised streams are shown in Table 3, “Limits of Detailed Study”

Table 3. Limit Of Detailed Study

| <u>Stream Name</u> | <u>Limits Of Detailed Study</u> |
|-----------------------------------|---|
| 3rd Avenue – Kagy Boulevard Split | From the confluence with Figgins Creek to the diversion of Figgins Creek |
| Baker Creek | From the approximately 0.8 mile from the confluence with West Gallatin River to the diversion from West Gallatin River |
| Baker Creek (Area) Overflow | From the confluence with the West Gallatin River upstream to approximately 11 miles upstream. |
| Baker Creek West Overflow | From the confluence with Camp Creek upstream to the divergence from the West Gallatin River. |
| Black Avenue Split | From the confluence with Garfield Street Split to the diversion of Flat Creek |
| Bozeman Creek | From the confluence with the East Gallatin River upstream to approximately 0.18 miles upstream of Nash Road |
| Bridger Creek | From the confluence with the East Gallatin River to approximately 0.18 mile upstream of Fish Hatchery Road. The 2007 Anderson re-study only included the reach from the confluence with the East Gallatin River to approximately 1.0 river mile upstream of Story Mill Road. |
| Buster Gulch | From approximately 0.9 mile upstream of Airport Road to approximately 0.5 upstream of Sunny Access Drive. |

Table 3. Limit Of Detailed Study

| <u>Stream Name</u> | <u>Limits Of Detailed Study</u> |
|--|---|
| Camp Creek | From the confluence with Baker Creek Area to its confluence with Baker Creek West Overflow |
| Cedar Street Split | From the confluence with Mill Ditch Diversion to the Diversion from Mill Ditch Diversion |
| Church Avenue Split | From the confluence with Bozeman Creek to the Diversion from Bozeman Creek |
| East Gallatin River | From the confluence with the Gallatin River to approximately 1.1 miles upstream of Kelly Canyon Road. The 2007 Anderson re-study was from Bozeman waste water treatment plant west of Springhill Road to approximately 8.6 miles upstream. |
| East Gallatin River Golf Course Reach | From the confluence with the East Gallatin River Springhill Reach to approximately 0.4 mile upstream (entire length). |
| East Gallatin River Overflow Reach | From the confluence with the East Gallatin River to approximately 2.8 miles upstream (entire length). |
| East Gallatin River Spillway Reach | From the confluence with the East Gallatin River Overflow Reach to approximately 0.5 mile upstream (entire length). |
| East Gallatin River Springhill Reach | From the confluence with East Gallatin River Overflow Reach to approximately 0.4 mile upstream (entire length). |
| Figgins Creek | From the confluence with Mathew-Bird Creek to approximately 0.3 mil upstream of Alder Creek Road |
| Flat Creek | From the confluence with Rouse Avenue Split to approximately 500 feet downstream of Mathew Bird Circle |
| Flat Creek – East Kagy Boulevard Split | From the confluence with Mathew-Bird Creek to the Diversion from Flat Creek |
| Gallagator Split | From the confluence with Mill Ditch Diversion to the Diversion from Bozeman Creek |
| Garfield Street Split | From the confluence with Rouse Avenue Split to the Diversion from Mathew-Bird Creek |
| Golf Course Split | From the confluence with Flat Creek to the Diversion from Nash-Spring Creek |

Table 3. Limit Of Detailed Study

| <u>Stream Name</u> | <u>Limits Of Detailed Study</u> |
|--------------------------|---|
| I90 Diversion | From the confluence with Baker Creek to the Diversion from Mill Ditch |
| I90 Lateral | From the confluence with Interstate Diversion to the Diversion from West Gallatin River |
| Interstate 90 Split | From the confluence with East Gallatin River to the Diversion from Mill Ditch Diversion |
| Jefferson River | From approximately 3.5 miles upstream of the Madison River to approximately 120 feet upstream of Frontage Road |
| Kagy Rouse Split | From the confluence with Bozeman Creek to the Diversion from Nash-Spring Creek |
| Linney Road Split | From the confluence with Baker Creek Overflow to The Diversion from Baker Creek |
| Lower Black Avenue Split | From the confluence with Rouse Avenue Split to the Diversion from Golf Course Split |
| Madison River | From approximately 2.5 miles upstream of the confluence with the Jefferson River to approximately 1.2 miles upstream of Interstate Highway 90 |
| Mathew-Bird Creek | From the confluence with Bozeman Creek to approximately 0.6 mile upstream of Goldenstein Lane |
| Mill Ditch Diversion | From the confluence with the East Gallatin River to the confluence with Bozeman Creek. |
| Moreland Ditch | From the confluence with Bozeman Creek to The Diversion from Bozeman Creek |
| Museum Split | From the confluence with Figgins Creek to the Diversion from Flat Creek |
| Nash Road Split | From the confluence with Bozeman Creek to the Diversion from Bozeman Creek |
| Nash-Spring Creek | From the confluence with Bozeman Creek to approximately 0.6 mile upstream of Goldenstein Lane. |
| Rain Roper Split | From the confluence with Mathew-Bird Creek to Diversion from Mathew-Bird Creek |
| Rouse Avenue Split | From the confluence with Bozeman Creek the Diversion from Flat Creek |

Table 3. Limit Of Detailed Study

| <u>Stream Name</u> | <u>Limits Of Detailed Study</u> |
|-----------------------------|--|
| Sourdough Trail Split | From the confluence with Nash-Spring Creek to the Diversion from Bozeman Creek |
| Tracy Avenue Split | From the confluence with Mathew-Bird Creek to Diversion from Figgins Creek |
| West Gallatin River | From the confluence with East Gallatin River to approximately 4.0 mile upstream of Mill Street |
| West Gallatin East Overflow | From the confluence with West Gallatin River to the Overflow point from West Gallatin River |

2.2 Community Description

Gallatin County is located in southwestern Montana. It is bordered by Broadwater and Meagher Counties to the north; Park County and Yellowstone National Park to the east; Fremont County and the State of Idaho to the south; and Madison and Jefferson Counties to the west.

The headwaters of numerous streams are located in Gallatin County that forms in part, the Gallatin and Madison Rivers. The Gallatin River joins the Madison and Jefferson Rivers to form the Missouri River in the northwestern part of the county, near the City of Three Forks. Gallatin County has experienced a continuous growth in population. The US Census Bureau estimates the population of Gallatin County in 2014 as 97,308 (Reference 17).

The City of Bozeman, the county seat, is located in central Gallatin County, in southwestern Montana along Bozeman Creek, which, along with the tributaries of Rocky, Bear, and Bridger Creeks, forms the East Gallatin River. The city is entirely surrounded by unincorporated areas of Gallatin County. The US Census Bureau estimates the population of the City of Bozeman in 2014 as 41,660 (Reference 17).

The City of Three Forks is located in western Gallatin County, in southwestern Montana. The city is bounded on the east by the Madison River and on the west and north by the Jefferson River. The city is bounded at the northwest corner by Broadwater County. The remaining limits are bordered by unincorporated area of Gallatin County. The US Census Bureau estimates the population of City of Three Forks in 2009 as 1,970 (Reference 17).

The climate in Gallatin County is characterized by warm summers and cold winters. The mean annual temperature varies from 43 degrees Fahrenheit (°F) in the City of Bozeman to 46°F in the City of Three Forks. The average maximum temperature for Bozeman is 80°F and for Three Forks is 87°F. The average minimum temperatures are 11°F and 10°F, respectively. Extremes range from high temperatures above 100°F in July and August to lows below -40°F during winter. Average annual precipitation varies from

approximately 12 inches at

Three Forks to approximately 18 inches at Bozeman (Reference 18). Average annual precipitation at the top of the mountain ranges at the head of various drainages varies from 40 inches in the Jefferson River basin to 60 inches in the Gallatin and Madison River basins (Reference 19).

2.3 Principal Flood Problems

Flood flows on the streams studied in detail are caused primarily by snowmelt or snowmelt and rain during the months of April, May, and June. The county is subject to warm, westerly Chinook winds that are usually responsible for the rapid snowmelt. Flooding can also be caused by ice jams forming in the winter. This problem is especially prevalent on the Madison River.

Bozeman Creek, Bridger Creek, East Gallatin River

Most severe flooding events in the Bozeman Creek watershed (HUC 12 100200080905) have been produced either from high snowmelt, or rain on snow events. Notable flooding within this watershed has occurred numerous times, most recently in May 2011. In the May 25, 2011, edition of the Bozeman Daily Chronicle (Reference 20), multiple pictures show the extensive flooding that occurred along Bozeman Creek. During that flooding event, water spilled out of the banks of Bozeman Creek, finding alternative flowpaths in some locations. Many culverts and bridges, particularly in the downtown area, were overtopped and water flowed freely down roads and caused damage to numerous structures. Per information in a May 26, 2011, Bozeman Daily Chronicle article (Reference 21), Bozeman Creek overtopped Mendenhall Street and Kagy Boulevard causing multiple road and sidewalk closures. The floodwaters threatened numerous commercial buildings in the downtown areas as well.

Notable flooding occurred along Bozeman Creek in April 1893, with the most recent occurring in April 1977. In 1948, heavy snowfall for 2 weeks throughout the East Gallatin River valley was followed by a period of warm weather. Maximum temperatures reached 68°F, resulting in rapid snowmelt and heavy surface runoff. The crest of the flood occurred on April 15, 1948. Runoff from farm land south of Bozeman entered the city and flowed northerly, causing considerable flood damage. This was the maximum flood of record. There are no known high-water marks existing for any of these flooding events.

Bridger Creek flooding is generally restricted to areas along the main channel because it is fairly well entrenched; however, overtopping can occur along the low bank just south of the bridge on State Highway 86, causing minor flooding along Bridger Drive in Bozeman.

Flooding along East Gallatin River north of Bozeman spreads out over a wide flood plain area. At numerous places, the bottom of the river channel is higher in elevation than flood plain land away from the channel. When flooding occurs, overland flows often travel considerable distances downstream before they can return to the main channel.

West Gallatin River

The studied portion of West Gallatin River has numerous areas where the river flows through a number of braided, unstable channels. In some cases, the riverbed is higher than nearby flood plain land. Debris jams, or ice jams, can cause the river to flood at

unpredictable places. The United States Army Corps of Engineers (USACE) reported that ice jams have caused higher flood stages downstream at Logan, Montana and downstream of Interstate Highway 90. The maximum flood of record occurred on June 1997 as a result of rapid snowmelt. A peak discharge of 9,160 cubic feet per second (cfs) was recorded on June 2, 1997 at U.S. Geological Survey (USGS) gage 06043500 near Gallatin Gateway. Erosion damage to roads, bridges, and irrigation structures has been most severe from prolonged high snowmelt runoff (Reference 22).

Notable flooding has occurred since 1952, with the most recent occurring in 1975. The maximum flood of record occurred in June 1974 as a result of rapid snowmelt. A peak discharge of 9,690 cubic feet per second (cfs) was recorded on June 17, 1974, at the U.S. Geological Survey (USGS) gage near Gallatin Gateway (No. 6-0435). This flood had an estimated recurrence interval of 35 years. A discharge of 12,350 cfs will cause more overflow in Baker Creek and Camp Creek than occurred during the 1974 flood.

City of Three Forks Area

The two principal sources of flooding in the Three Forks area are the Jefferson River, northwest of Three Forks, and the Madison River, east of Three Forks. Flooding from the Jefferson River has usually occurred during the high spring runoff period in May and June. Flooding from the Madison River has primarily been due to ice jams and overtopping or failure of protective levees.

Jefferson River

The most recent major flood on the Jefferson River occurred in 1948 (estimated to have been equal to a 4-percent-annual-chance flood) with a flow of 19,900 cfs recorded at the USGS gage near Sappington (No. 6-0345) just upstream of Three Forks. Floodwater overtopped U.S. Highway 10 west of the overpass at the Chicago, Milwaukee, St. Paul and Pacific Railroad southwest of Three Forks. Floodwater entered the western part of Three Forks and flowed northerly.

A base (1-percent-annual-chance) flood elevations (BFEs) of the Jefferson River is expected to produce a flood flow that would exceed the capacity of Jefferson River above U.S. Highway 10. Water would flow easterly to the intersection of the U.S. Highway 10 overpass and the Chicago, Milwaukee, St. Paul and Pacific Railroad west of Three Forks. Here, the water will overtop both highway and railroad, allowing floodwater to enter Three Forks on both sides of the railroad tracks.

A potential for increased flooding at Three Forks from the Jefferson River exists from the restriction of the flood plain caused by Interstate Highway 90. This would force water over the Chicago, Milwaukee, St. Paul and Pacific Railroad tracks north of Three Forks, where it would then flow back into the city (Reference 23).

Madison River

Prior to construction of the Madison River dike in 1920, flooding occurred nearly every year, inundating parts of the valley floor (Reference 24). There is no record of major flooding in Three Forks from the Madison River.

The 1-percent-annual-chance ice jam flood is expected to force the Madison River over the west levee or break out of the channel upstream of the levee. Water would move

northwesterly and be impounded by the highway system, causing it to back up into Three Forks.

2.4 Flood Protection Measures

Nonstructural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land-use regulations adopted from the code of Federal and State regulations that control building within areas that have a high risk of flooding. Gallatin County does have flood plain zoning in effect. Construction is restricted within the confines of the 1- percent-annual-chance flood plain. Construction is allowed if buildings are flood proofed or built with a first floor elevation equal to or greater than 2 feet above the 1-percent-annual-chance flood elevation. Areas within this study that have a defined 1-percent-annual-chance flood plain are Bozeman Creek, Bridger Creek, East Gallatin River, and West Gallatin River.

There are no major flood-control structures on Bozeman Creek, Bridger Creek, or East Gallatin River. There is a minor flood control structure adjacent to East Gallatin River at the Riverside Country Club, 2 miles northwest of Bozeman. However, this structure does not provide flood protection against the 1-percent- annual-chance flood event.

West Gallatin River can be considered a wild and Natural River until it breaks out of the canyon onto the valley floor. From the mouth of the canyon downstream to Interstate Highway 90, there are several irrigation diversions that can significantly reduce channel flow; the major diversions alone can account for approximately 1,500 cfs. Also, there are several minor earthen berms which have been built along portions of the main channel of West Gallatin River to prevent overflow to the west into Baker Creek.

The Jefferson River has several dams on its tributaries, but these have little modifying effect on peak discharges. The Chicago, Milwaukee, St. Paul and Pacific Railroad bed acts as a levee like structure when flows from the Jefferson River overtop U.S. Highway 10, as in 1948. These provide some protection for the City of Three Forks, on the east side of the railroad, from Jefferson River flooding of a 4-percent-annual-chance or less recurrence interval.

The USACE completed a study and plan for a protective dike to be constructed on the west side of City of Three Forks. This dike would protect Three Forks from Jefferson River floods (Reference 23). The current status of this project is unknown.

The Madison River is controlled to some degree by the operations of Hebgen Dam, Quake Lake, and Ennis Lake that are all located upstream of the study area. Hebgen Lake especially can have some modifying effect on peak discharges, depending on how it is managed.

Levees have been built on both sides of Madison River in the area east of Three Forks. The first levee was constructed in 1919-1920 to protect low-lying land east of Three Forks (Reference 23). Following the ice jam flood of 1949, levees were rebuilt and raised. The levees now direct river flows through several railroad and highway bridges that have a large capacity, except during winter periods when the channel freezes up and becomes blocked with ice. The east levee is higher than the west levee, preventing water from flowing easterly as in the 1949 flood. The east levee and Interstate Highway 90 put additional pressure on the west levee south of the highway. During winter ice jams, failure or overtopping of the west levee can occur, allowing water to back into Three Forks. The

potential for damaging floods in Three Forks has been increased due to the rebuilding of the east levee and interstate highway construction in the mid-1960s. This is evidenced by the recent ice jam floods of 1972, 1975, and 1978 that backed water in near city development.

The levees along Madison River should not be considered adequate for full flood protection. Additional rebuilding and protective riprap are needed for this levee system. The upper portion of the west levee is particularly vulnerable where the Madison River flows adjacent to the levees.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent-chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting each community.

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The hydrologic analysis was divided into three general areas: (1) the area around the City of Bozeman involving East Gallatin River, Bridger Creek, and Bozeman Creek; (2) the area along West Gallatin River; and (3) the area around the City of Three Forks involving the Jefferson and Madison Rivers.

Bozeman Area

Peak discharges for the selected recurrence intervals for each gage site used in the original analysis discussed below were computed using log-Pearson Type III analysis (Reference 25).

To estimate peak discharge-frequency relationships for the detailed studied streams, regression equations using peak discharge for a selected frequency and drainage area were developed for 10 gages on streams in or near the study area. While these estimates of peak discharge for a selected frequency do not agree exactly with the analysis of the data for any one gage on streams in the study area, the results do correlate well.

Because all gages on streams within the study area had records of 25 years or less, the regional equations are considered more reliable. Therefore, these equations were used to develop peak discharge- frequency relationships for all detailed studied streams in this area.

USGS gage records in this area are Rocky Creek near Bozeman (No. 6-0465, 20 years of record); East Gallatin River at Bozeman (No. 6-0480, 22 years of record); Bear Canyon Creek near Bozeman (No. 6-0470, 18 years of record); and Bridger Creek near Bozeman (No. 6-0485, 25 years of record) (Reference 26, 27, and 28).

Discharges for Buster Gulch near Bozeman were determined by split flow analysis of the junction where floodwater spills from the East Gallatin River floodplain into the Buster Gulch channel.

The hydrologic analysis that was developed in 1996 for the adjacent reach of the East Gallatin River was reviewed and adopted for the 2002 Anderson Study.

The stream gage for the East Gallatin River near Bozeman (USGS 0604800) was analyzed following the methods described in *Guidelines for Determining Flood Flow Frequency, Bulletin 17B* (Reference 29). There were 23 years of record, with continuous record from 1940 through 1961 and with 1981 as an historic event. The flood of 1981 was the largest during the period from 1940 through 1995. The flood of 1997 was probably the second largest since 1940; however, the peak discharge was not recorded in 1997.

To extend the record and improve the flood frequency analysis for the East Gallatin River, a two-station comparison was made between gauge (0604800) and the Gallatin River gauge at Logan (06052500). The gauge at Logan had 73 years of record. A good correlation was obtained between the two records. The analysis resulted in increased discharges for the East Gallatin River.

The study reach is located downstream several miles from the USGS stream gage (06052500). The drainage area at the stream gage is 148 square miles and in the study reach is 262 square miles. A regional analysis was made to determine the flood frequency discharge in the study reach. Data from 13 stream gages in the region was used for the regional analysis. Most of these streams, like the East Gallatin, have their headwaters in the Bridger or Gallatin Mountain Ranges and have similar watershed and climate characteristics.

The best equation related the 1-percent-annual-chance peak discharge (Q_{100}) to drainage area (A), watershed elevation (E), and percent above 6,000 feet elevation (HE). The 1-percent-annual-chance discharge for various locations on the East Gallatin was then determined by the ratio of the regional equation to the East Gallatin gauge values as follows:

$$Q_{100} = 2305 (A/148)^{.601} (E/6.21)^{5.456} (HE/51)^{-1.398}$$

The value of 2,305 cfs is the 1-percent-annual-chance peak discharge at the Bozeman stream gage. The peak discharges at other frequencies were assumed to be proportional to the values of those frequencies at the Bozeman stream gage.

Peak discharges for the 10, 2, 1 and 0.2-percent-annual-chance storms were arrived at by analyzing three existing flood studies of this stretch of the East Gallatin River and Bridger Creek. After carefully analyzing these values they were found to be accurate up until the confluence of the East Gallatin River with Bridger Creek. Beginning at the confluence, the referenced peak discharge values from the 2003 Old River Farm/Manley Meadows Hydrology and Hydraulic Analyses were used. In that report the values at the confluence were updated by NRCS to reflect small out-of-bank losses to the west. These values were recommended for use in modeling the East Gallatin River upstream of Manley Road by the NRCS, and were in turn used in the 2007 Anderson re-study from the confluence to the downstream end of the study.

Peak discharge values for Bridger Creek beginning at the Story Mill Road bridge were referenced from the 2002 hydraulic report for the MDOT BR 86-1(23)3 CN 4230 project. In that report peak discharge values were calculated for the purposes of the design and construction of a new bridge over Bridger Creek.

West Gallatin River Area

Records from the USGS gage, West Gallatin River near Gallatin Gateway (No. 6-0435), were used to estimate peak discharge-frequency relationships in this area (Reference 29, 30, and 31). The study area includes several secondary channels into which floodwater flows as West Gallatin River water-surface elevations rise. The peak discharges developed for this area were routed among these various channels based on the capacity of each.

Peak discharges developed from the West Gallatin River gage near Gallatin Gateway were consistently higher than the regional equation developed from data on 19 gages in the area. These estimated peak discharges are valid because this gage record is 52 years in length, includes the recent high flow years of the 1970s, and has drainage with higher precipitation.

Peak discharges for the entire reach were developed using a ratio of the drainage area at the gage to the drainage area at a particular point raised to the exponent developed in the regional regression analysis.

There are several irrigation diversions on West Gallatin River between the USGS gage near Gallatin Gateway and Interstate Highway 90. The larger of these historically has accounted for a reduction in flow of approximately 1,500 cfs; however, for the purpose of this study, the diversions were not assumed to be operating. There is no assurance that they would be operating or operable during a major flood event.

Peak discharges for the local watershed which drains into the Baker Creek Area and the Camp Creek Watershed were developed using a regression equation similar to the one cited earlier. These local peak discharges would not contribute to the West Gallatin River peak because of the great difference in times of concentration. This can be attributed to the fact that the individual watersheds of these tributaries are much smaller in comparison to the West Gallatin River.

Three Forks Area

The peak discharge-frequency relationship for Madison River at the City of Three Forks was based on regional regression equations developed using peak discharges for

selected frequencies and drainage area data from 19 selected USGS stream gages in the surrounding area.

Two gages on Madison River were included in this analysis. One is USGS gage No. 6-0410, Madison River below Ennis Lake near McAllister, which has 34 years of record; and the other is USGS gage No. 6-0425, Madison River near Three Forks, which has 16 years of record (Reference 26, 27, and 28). Estimates of peak discharges from direct analyses of these gages, using log-Pearson Type III analysis (Reference 25) equations, compared very closely with estimates from the regression equations. Because neither of these records on Madison River was long enough to be completely reliable, the regression equations were considered to give more reliable estimates of the discharge frequency relationship on Madison River at the City of Three Forks. The 17 other gages used in the development of the regression equations were located in the Gallatin and Jefferson River drainage basins.

A problem which is especially prevalent on Madison River is flooding caused by ice jams during the winter. To develop flood flow-frequency information for this period, records for the USGS gage near Three Forks (No. 6-0425) were used. Maximum monthly flows for December, January, and February were analyzed. The discharge-frequency curve for January gave the highest estimates of flow for this period. These values were projected to Three Forks using a ratio of drainage areas to the 0.65 power. It was assumed for the purposes of this analysis that 50 percent of the Madison River flows during ice jam conditions would remain within the levees, and the remaining 50 percent would spillover the west levee and backup into Three Forks. This assumption was supported by comparison with historic flood elevations.

The peak discharge-frequency relationship for Jefferson River near the City of Three Forks was also based on the regression equations used for Madison River. Three gages on the main stem of Jefferson River were included in the analysis. They were USGS gage No. 6-0265, Jefferson River near Twin Bridges, which has 17 years of record; USGS gage No. 6-0272, Jefferson River near Silverstar, which has 26 years of record; and USGS gage No. 6-0345, Jefferson River near Sappington, which has 40 years of record (Reference 26, 27, and 28). The gage near Sappington is closest to Three Forks. The regression equation gives estimates of peaks for selected frequencies that were higher than those computed directly from the data for the Sappington gage and the Twin Bridges gage using log-Pearson Type III analysis (Reference 25). However, the peaks computed from the data at the Silverstar gage were higher than those from the regression equations. To balance out this inconsistency, as well as take full advantage of as much data as possible, the regression equation was considered to yield a more reliable estimate of peak discharges for Jefferson River near Three Forks. The regression equation was, therefore, used to estimate the 1-percent-annual-chance peak discharge. The slope of the discharge-frequency line developed for the gage near Sappington was used to estimate discharges for other frequencies at the City of Three Forks. Peak discharges for all local drainages were developed using the regional regression equation directly.

This Revision to the Countywide:

Revised hydrologic analyses for the primary flooding sources in the Bozeman Creek watershed were completed by Respec from January 2014 to April 2014 in order to establish discharges for the 10-, 4-, 2-, 1, and 0.2-percent-annual-chance flood events for use in the hydraulic analysis (Reference 20-21-and 32 to 35). Each analysis included of several different regression equations, a rainfall runoff model, and the effective discharge

rates, as well as a recommendation for the discharges that should be used in the hydraulic model.

This study also updates approximately 30 miles of the West Gallatin River, beginning at the confluence with the East Gallatin River and extending upstream approximately four river miles above of the community of Gallatin Gateway, Montana. Two active United States Geological Survey (USGS) gaging stations are located in the vicinity of the study area. The USGS gage 06043500 Gallatin River near Gallatin Gateway is on the West Gallatin River approximately six miles above the study area and has been in operation since 1890. USGS gage 06052500 Gallatin River at Logan, MT is approximately 5.6 miles below the confluence of the West and East Gallatin Rivers (downstream limit of study area) and has been in operation since 1895. A third USGS gaging station (USGS gage 06044000 Gallatin River near Salesville, MT) is no longer in service, but was operational from 1895 to 1923. This gage was located approximately 3.7 miles downstream of the Gallatin Gateway gage.

The hydrologic analyses included flood frequency analysis following Bulletin 17B Guidelines at two stream gages (USGS 1982), along with drainage-area ratio adjustments for estimating peaks at ungagged sites per USGS WRIR 03-4308 (Parrett & Johnson 2004). The USGS PeakFQ software program (Flynn, Kirby and Hummel 2006) was used to perform the log-Pearson III flood frequency analysis. The analysis was summarized in the hydrologic report title 'Hydrology Design Report, West Gallatin River, Gallatin County, MT (MMI 2015) which was reviewed and approved by FEMA's National Service Provider (NSP) and the MT DNRC as documented in their letters dated April 6, 2015 and April 7, 2015, respectively

A summary of drainage area-peak discharge relationships for each stream studied in detail is shown in Table 4, "Summary of Discharges".

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| 3 rd Avenue - Kagy Split | | | | | | | |
| At divergence from Figgins Creek | *1 | 1,324 | 40 | 89 | 122 | 144 | 196 |
| Baker Creek | | | | | | | |
| Confluence with West Gallatin River Lateral Weir | *1 | 4,991 | 1,073 | 1,324 | 1,517 | 1,717 | 2,375 |
| Confluence with West Gallatin River Lateral Weir | *1 | 8,777 | 1,007 | 1,199 | 1,347 | 1,505 | 2,070 |
| Confluence with West Gallatin River Lateral Weir | *1 | 15,615 | 920 | 1,062 | 1,170 | 1,287 | 1,778 ² |
| Confluence with Baker Creek Overflow | *1 | 42,252 | 809 | 928 | 1,012 | 1,096 | 1,297 |
| Flow Split to Linney Road Reach | *1 | 62,594 | 202 | 216 | 221 | 229 | 248 |
| Flow from West Gallatin River Lateral Weir | *1 | 63,500 | 405 | 432 | 443 | 458 | 495 |
| Upstream Limit | *1 | 65,547 | 303 | 322 | 328 | 339 | 367 |
| Baker Creek Overflow | | | | | | | |
| Confluence with Linney Road Reach | *1 | 16,295 | 793 | 910 | 993 | 1,076 | 1,276 |
| Confluence with Moreland Ditch | *1 | 27,543 | 776 | 892 | 973 | 1,056 | 1,254 |
| Confluence with West Gallatin River Lateral Weir | *1 | 30,562 | 211 | 299 | 370 | 444 | 623 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|---|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Confluence with West Gallatin River Lateral Weir | *1 | 31,012 | 158 | 221 | 270 | 319 | 428 |
| Confluence with West Gallatin River Lateral Weir | *1 | 32,965 | 159 | 221 | 269 | 317 | 421 |
| Upstream Limit | *1 | 33,456 | 24 | 49 | 70 | 92 | 142 |
| Black Avenue Split | | | | | | | |
| At divergence from Flat Creek | *1 | 2,972 | 14 | 17 | 19 | 26 | 35 |
| Bozeman Creek | | | | | | | |
| At I-90 | 50 | 3,817 | 526 | 705 | 863 | 1,047 | 1,525 |
| Downstream of confluence with Wallace Avenue Split | *1 | 4,795 | 519 | 696 | 851 | 1,027 | 1,495 |
| At Aspen Street | *1 | 5,858 | 483 | 627 | 775 | 944 | 1,398 |
| Downstream of confluence with Church Avenue Split | *1 | 6,765 | 476 | 616 | 761 | 924 | 1,378 |
| At Lamme Street | *1 | 8,566 | 458 | 570 | 707 | 863 | 1,302 |
| At Mendenhall Street | *1 | 8,948 | 454 | 562 | 698 | 853 | 1,291 |
| At Olive Street | *1 | 10,202 | 450 | 551 | 685 | 839 | 1,273 |
| Approximately 150 feet upstream of Story Street | 50 | 11,561 | 512 | 685 | 837 | 1,007 | 1,475 |
| At Mill Ditch Diversion Structure | *1 | 11,829 | 512 | 685 | 837 | 1,007 | 1,411 |
| Approximately 100 feet upstream of Mill Ditch Diversion Structure | *1 | 11,927 | 531 | 724 | 877 | 1,039 | 1,447 |
| Just downstream of Gallagator Split | *1 | 12,135 | 531 | 726 | 884 | 1,052 | 1,485 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Just downstream of confluence with Rouse Avenue Split | *1 | 13,969 | 541 | 757 | 935 | 1,130 | 1,630 |
| Just downstream of confluence with Kagy/Rouse Split | *1 | 18,559 | 387 | 497 | 592 | 682 | 969 |
| Just downstream of confluence with Nash Spring Creek | *1 | 20,724 | 387 | 489 | 567 | 636 | 818 |
| Just upstream of confluence with Nash Spring Creek | *1 | 20,786 | 343 | 427 | 490 | 543 | 688 |
| Downstream of divergence of Sourdough Trail Split | *1 | 27,296 | 338 | 420 | 475 | 532 | 668 |
| Approximately 3,400 feet downstream of Goldenstein Lane | *1 | 27,305 | 338 | 422 | 478 | 538 | 678 |
| Approximately 3,000 feet downstream of Goldenstein Lane | *1 | 28,687 | 453 | 630 | 751 | 879 | 1,172 |
| At Goldenstein Lane | *1 | 31,772 | 388 | 538 | 644 | 743 | 972 |
| Approximately 500 feet upstream of Goldenstein Lane | *1 | 32,217 | 377 | 523 | 625 | 720 | 953 |
| At confluence with Nash Road Split | *1 | 45,459 | 377 | 525 | 647 | 777 | 1,120 |
| At Nash Road | 30 | 47,091 | 374 | 468 | 517 | 553 | 605 |
| Approximately 400 feet upstream of Nash Road | *1 | 47,519 | 375 | 517 | 628 | 737 | 995 |
| Upstream limit of detailed study - approximately 900 feet upstream of Nash Road | *1 | 47,979 | 377 | 525 | 647 | 777 | 1,120 |

Table 4. Summary of Discharges

| Flooding Source and Location | | Drainage Area (Square Miles) *1 Data not Available | Hydraulic Cross Section | Peak Discharges (cubic feet per second) | | | | |
|---|-----|--|----------------------------|---|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | | | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Bridger Creek | | | | | | | | |
| At confluence with East Gallatin River | 70 | | | 790 | | 1,170 | 1,350 | 1,810 |
| At upstream limit of study | 64 | | | 725 | | 1,090 | 1,260 | 1,700 |
| Buster Gulch | | | | | | | | |
| Entire Reach | *1 | | | 407 | | 582 | 673 | 898 |
| Cedar Street Split | | | | | | | | |
| At divergence from Mill Ditch Diversion | *1 | 1,312 | | 19 | 52 | 69 | 88 | 137 |
| Church Avenue Split | | | | | | | | |
| At Fridley Street | *1 | 865 | | 17 | 47 | 54 | 61 | 76 |
| At Davis Street | *1 | 1,306 | | 23 | 57 | 65 | 73 | 89 |
| At Lamme Street | *1 | 1,689 | | 27 | 65 | 75 | 84 | 102 |
| At Mendenhall Street | *1 | 2,069 | | 36 | 82 | 92 | 103 | 125 |
| At Main Street | *1 | 2,436 | | 48 | 106 | 119 | 133 | 161 |
| At divergence from Bozeman Creek | *1 | 3,601 | | 62 | 135 | 151 | 169 | 203 |
| East Gallatin River | | | | | | | | |
| At Airport Road | 262 | | | 1,810 | | 2,880 | 3,420 | 4,900 |
| Near Commercial Drive | 162 | | | 1,510 | | 2,130 | 2,390 | 3,030 |
| At confluence with Bozeman Creek | 148 | | | 1,410 | | 1,990 | 2,250 | 2,880 |
| At Griffin Drive | 96 | | | 1,100 | | 1,590 | 1,810 | 2,360 |
| At confluence with Mill Ditch Diversion | 95 | | | 1,100 | | 1,560 | 1,770 | 2,290 |
| Approximately 1.3 miles upstream from CMSP&P Railroad | 95 | | | 1,000 | | 1,460 | 1,670 | 2,190 |
| Figgins Creek | | | | | | | | |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Approximately 450 feet downstream of Kagy Boulevard | *1 | 280 | 39 | 58 | 66 | 93 | 142 |
| Approximately 400 feet downstream of Kagy Boulevard | *1 | 322 | 49 | 76 | 92 | 124 | 187 |
| Approximately 300 feet downstream of Kagy Boulevard | *1 | 414 | 51 | 84 | 108 | 149 | 235 |
| Downstream of Kagy Boulevard | *1 | 514 | 91 | 149 | 198 | 240 | 360 |
| Approximately 400 feet downstream of 3rd Avenue | *1 | 1,431 | 51 | 60 | 76 | 96 | 164 |
| At 3rd Avenue | *1 | 1,862 | 46 | 53 | 67 | 85 | 150 |
| Downstream of confluence with Museum Split | *1 | 2,198 | 86 | 142 | 189 | 229 | 346 |
| Approximately 300 feet downstream of Overbrook Drive | *1 | 2,711 | 81 | 123 | 154 | 179 | 249 |
| Approximately 600 feet upstream of Overbrook Drive | *1 | 3,970 | 48 | 70 | 85 | 98 | 129 |
| Downstream of divergence of Museum Split | *1 | 4,026 | 35 | 49 | 59 | 65 | 77 |
| Approximately 800 feet downstream of Brookdale Drive | *1 | 5,882 | 40 | 68 | 94 | 115 | 174 |
| At Brookdale Drive | *1 | 6,766 | 23 | 42 | 58 | 72 | 110 |
| Approximately 200 feet upstream of Alder Creek Drive | *1 | 7,747 | 15 | 27 | 38 | 48 | 75 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Upstream limit of study - approximately 1,500 feet upstream of Alder Creek Road | *1 | 9,071 | 10 | 19 | 27 | 34 | 52 |
| Flat Creek | | | | | | | |
| Downstream of Black Avenue | *1 | 1,191 | 29 | 29 | 31 | 31 | 33 |
| Approximately 120 feet downstream of Kagy Boulevard | *1 | 1,319 | 57 | 63 | 68 | 82 | 97 |
| Approximately 100 feet downstream of Kagy Boulevard | *1 | 1,344 | 60 | 66 | 72 | 90 | 106 |
| Just upstream of Kagy Boulevard | *1 | 1,592 | 67 | 74 | 82 | 112 | 133 |
| Approximately 300 feet upstream of Kagy Boulevard | *1 | 1,702 | 90 | 168 | 232 | 308 | 420 |
| Downstream of confluence with Golf Course Split | *1 | 1,808 | 91 | 176 | 248 | 336 | 515 |
| Upstream limit of study - approximately 500 feet downstream of Mathew Bird Circle | *1 | 5,566 | 11 | 17 | 22 | 26 | 38 |
| Flat/Kagy Split | | | | | | | |
| At divergence from Flat Creek | *1 | 697 | 23 | 102 | 167 | 224 | 362 |
| Gallagator Split | | | | | | | |
| At divergence from Bozeman Creek | *1 | 279 | 10 | 31 | 51 | 78 | 145 |
| Garfield Street Split | | | | | | | |
| Just downstream of Black Avenue | *1 | 1,212 | 10 | 96 | 163 | 218 | 438 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|---|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Just upstream of Black Avenue | *1 | 1,371 | 14 | 113 | 190 | 257 | 518 |
| At divergence from Mathew Bird Creek | *1 | 1,459 | 15 | 121 | 205 | 277 | 565 |
| Golf Course Split | *1 | 356 | 91 | 176 | 248 | 336 | 514 |
| | *1 | 482 | 91 | 184 | 273 | 380 | 610 |
| | *1 | 755 | 91 | 184 | 273 | 381 | 669 |
| | *1 | 1,084 | 91 | 179 | 263 | 357 | 598 |
| | *1 | 1,266 | 37 | 95 | 163 | 230 | 409 |
| | *1 | 1,419 | 37 | 95 | 162 | 224 | 369 |
| At divergence from Nash Spring Creek | *1 | 1,654 | 34 | 81 | 135 | 174 | 266 |
| I-90 Diversion | | | | | | | |
| Confluence with Heeb Road West | *1 | 3,667 | 221 | 256 | 293 | 341 | 647 |
| Upstream Limitt | *1 | 7,829 | 219 | 250 | 281 | 319 | 588 |
| I-90 Lateral | | | | | | | |
| Upstream Limitt | *1 | 7,615 | 2 | 6 | 12 | 23 | 60 |
| I-90 Split | | | | | | | |
| At divergence from Mill Ditch Diversion | *1 | 3,806 | 0 | 33 | 71 | 113 | 220 |
| Jefferson River | | | | | | | |
| At Three Forks | 9,600 | | 18,300 | | 25,000 | 27,600 | 34,000 |
| Kagy/Rouse Split | | | | | | | |
| Approximately 500 feet downstream of Kagy Boulevard | *1 | 556 | 0 | 8 | 25 | 45 | 151 |
| At divergence from Golf Course Split | *1 | 1,066 | 0 | 8 | 25 | 45 | 155 |
| Lower Black Split | | | | | | | |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| | *1 | 541 | 3 | 8 | 11 | 11 | 30 |
| | *1 | 622 | 3 | 7 | 8 | 13 | 23 |
| | *1 | 709 | 4 | 17 | 25 | 39 | 44 |
| | *1 | 867 | 4 | 17 | 25 | 39 | 44 |
| At divergence from Garfield Street Split | *1 | 1,266 | 4 | 17 | 28 | 39 | 81 |
| Linney Rd. Split | | | | | | | |
| Upstream Limitt | *1 | 4,181 | 202 | 216 | 221 | 229 | 248 |
| Madison River | | | | | | | |
| At Three Forks (Spring runoff) | 2,535 | | 8,000 | | 10,800 | 12,000 | 14,900 |
| At Three Forks (Winter runoff) | 2,535 | | 2,600 | | 3,295 | 3,550 | 4,135 |
| Mathew Bird Creek | | | | | | | |
| | *1 | 1,754 | 169 | 208 | 234 | 257 | 302 |
| Approximately 500 feet downstream of Garfield Street | *1 | 1,843 | 169 | 199 | 218 | 229 | 251 |
| At Garfield Street | *1 | 2,262 | 151 | 169 | 179 | 187 | 219 |
| Just upstream of Hoffman Drive | *1 | 5,117 | 165 | 282 | 369 | 444 | 737 |
| Approximately 100 feet downstream of Graf Street | *1 | 10,510 | 77 | 158 | 234 | 303 | 490 |
| Approximately 450 feet upstream of Graf Street | *1 | 11,096 | 71 | 150 | 224 | 290 | 473 |
| At confluence with Rain Roper Split | *1 | 14,073 | 62 | 133 | 200 | 260 | 428 |
| Approximately 1,400 feet downstream of Peace Pipe Lane | *1 | 14,294 | 61 | 100 | 114 | 126 | 144 |
| | *1 | 14,706 | 55 | 89 | 100 | 108 | 120 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| | *1 | 14,801 | 55 | 89 | 100 | 108 | 120 |
| | *1 | 15,247 | 56 | 99 | 116 | 130 | 150 |
| Approximately 300 feet downstream of Peace Pipe Lane | *1 | 15,481 | 56 | 111 | 145 | 171 | 214 |
| Just upstream of Peace Pipe Lane | *1 | 15,773 | 56 | 122 | 186 | 242 | 338 |
| Just upstream of Goldenstein Lane | *1 | 17,343 | 56 | 122 | 186 | 242 | 404 |
| Upstream limit of study - approximately 3,500 feet upstream of Goldenstein Lane | *1 | 20,778 | 19 | 34 | 47 | 58 | 88 |
| Mill Ditch Diversion | | | | | | | |
| Just downstream of I-90 | *1 | 79 | 92 | 130 | 138 | 143 | 157 |
| Just upstream of I-90 | *1 | 266 | 87 | 121 | 126 | 128 | 135 |
| Just downstream of confluence with Cedar Street Split | *1 | 282 | 87 | 154 | 197 | 241 | 355 |
| Just upstream of Cedar Street | *1 | 1,404 | 68 | 102 | 128 | 153 | 218 |
| Just downstream of confluence with Mill/Railroad Split | *1 | 1,611 | 87 | 154 | 197 | 241 | 355 |
| Approximately 650 feet downstream of Railroad Crossing | *1 | 2,322 | 87 | 154 | 197 | 239 | 291 |
| Just upstream of Railroad Crossing | *1 | 3,018 | 77 | 136 | 171 | 207 | 242 |
| | *1 | 3,534 | 57 | 97 | 132 | 161 | 176 |
| | *1 | 3,576 | 57 | 97 | 132 | 161 | 184 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|--|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Approximately 1,400 feet downstream of Main Street | *1 | 4,536 | 57 | 97 | 132 | 163 | 240 |
| Just upstream of Main Street | *1 | 5,973 | 35 | 72 | 98 | 123 | 158 |
| | *1 | 8,745 | 29 | 72 | 98 | 123 | 155 |
| At confluence with Gallagator Split | *1 | 8,938 | 29 | 72 | 98 | 123 | 219 |
| At divergence from Bozeman Creek | *1 | 9,226 | 19 | 41 | 45 | 45 | 74 |
| Mill Railroad Split | | | | | | | |
| At divergence from Mill Ditch Diversion | *1 | 815 | 0 | 0 | 0 | 2 | 64 |
| Moreland Ditch | | | | | | | |
| Upstream Limit | *1 | 1,870 | 566 | 593 | 603 | 612 | 631 |
| Museum Split | | | | | | | |
| At divergence from Flat Creek | *1 | 1,561 | 5 | 19 | 36 | 51 | 97 |
| Nash Road Split | | | | | | | |
| At divergence from Bozeman Creek | *1 | 2,373 | 3 | 57 | 130 | 224 | 515 |
| Nash Spring Creek | | | | | | | |
| | *1 | 458 | 68 | 90 | 102 | 116 | 131 |
| | *1 | 515 | 69 | 94 | 110 | 132 | 176 |
| | *1 | 669 | 69 | 95 | 113 | 140 | 203 |
| | *1 | 752 | 97 | 135 | 159 | 196 | 282 |
| | *1 | 896 | 122 | 179 | 212 | 267 | 392 |
| | *1 | 994 | 122 | 179 | 213 | 271 | 420 |
| | *1 | 1,064 | 122 | 179 | 213 | 273 | 431 |
| | *1 | 1,157 | 125 | 188 | 229 | 300 | 483 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|---|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| | *1 | 1,283 | 125 | 193 | 240 | 323 | 534 |
| At divergence of Golf Course Split | *1 | 1,436 | 156 | 254 | 335 | 441 | 710 |
| Approximately 300 feet downstream of confluence with Sourdough Trail Split | *1 | 4,176 | 159 | 274 | 375 | 497 | 800 |
| Downstream of confluence with Sourdough Trail Split | *1 | 4,609 | 157 | 271 | 373 | 493 | 795 |
| Approximately 150 feet downstream of Goldenstein Lane | *1 | 10,392 | 73 | 122 | 167 | 225 | 457 |
| At Goldenstein Lane | *1 | 10,574 | 62 | 104 | 153 | 207 | 420 |
| Upstream limit of study - approximately 3,500 feet upstream of Goldenstein Lane | *1 | 14,160 | 62 | 104 | 153 | 207 | 420 |
| Peace Pipe Split | | | | | | | |
| At divergence from Mathew Bird Creek | *1 | 2,877 | 0 | 0 | 0 | 0 | 66 |
| Rain Roper Split | | | | | | | |
| | *1 | 379 | 1 | 33 | 86 | 134 | 219 |
| | *1 | 525 | 1 | 33 | 86 | 134 | 218 |
| | *1 | 792 | 1 | 33 | 86 | 133 | 216 |
| | *1 | 1,023 | 0 | 21 | 63 | 103 | 173 |
| At divergence from Mathew Bird Creek | *1 | 1,180 | 0 | 12 | 42 | 72 | 125 |
| Rouse Avenue Split | | | | | | | |
| Below confluence with Garfield Street Split | *1 | 751 | 53 | 104 | 174 | 229 | 467 |
| Below confluence with | *1 | 3,380 | 53 | 58 | 63 | 86 | 107 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|---|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Flat Creek | | | | | | | |
| | *1 | 4,727 | 25 | 28 | 32 | 55 | 74 |
| At divergence from Flat Creek | *1 | 4,769 | 14 | 17 | 19 | 26 | 39 |
| Sourdough Trail Split | | | | | | | |
| At divergence from Bozeman Creek | *1 | 1,765 | 115 | 210 | 277 | 346 | 504 |
| Tracy Avenue Split | | | | | | | |
| At divergence from Figgins Creek | *1 | 840 | 54 | 95 | 137 | 153 | 225 |
| Wallace Avenue Split | | | | | | | |
| At Fridley Street | *1 | 2,786 | 36 | 69 | 76 | 84 | 98 |
| At Davis Street | *1 | 3,238 | 30 | 59 | 65 | 72 | 84 |
| At Lamme Street | *1 | 3,607 | 26 | 50 | 55 | 61 | 72 |
| At Mendenhall Street | *1 | 3,982 | 22 | 42 | 46 | 51 | 60 |
| At divergence from Church Avenue Split | *1 | 4,826 | 15 | 29 | 32 | 35 | 42 |
| West Gallatin River | | | | | | | |
| Headwaters of Gallatin River | 1,100 | -121 | 7,668 | 8,845 | 9,667 | 10,450 | 12,160 |
| East Overflow Flow Split | 1,098 | 20,324 | 7,653 | 8,739 | 9,491 | 10,205 | 11,735 |
| Confluence with Baker Creek | 1,097 | 21,688 | 7,664 | 8,766 | 9,535 | 10,269 | 11,859 |
| Flow Split to Baker Creek North I-90 | 1,097 | 24,752 | 7,081 | 7,942 | 8,516 | 9,037 | 9,961 |
| Flow Split to Baker Creek North I-90 | 1,096 | 26,546 | 7,181 | 8,105 | 8,724 | 9,293 | 10,321 |
| Flow Split to Baker Creek at I-90 | 1,079 | 38,860 | 7,296 | 8,276 | 8,938 | 9,548 | 10,655 |
| Flow Split to Baker Creek South I-90 | 1,075 | 42,105 | 7,418 | 8,424 | 9,114 | 9,760 | 11,124 |

Table 4. Summary of Discharges

| Flooding Source and Location | Drainage Area (Square Miles) *1 Data not Available | Peak Discharges (cubic feet per second) | | | | | |
|---|--|---|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|
| | | Hydraulic Cross Section | 10-Percent- Annual Chance | 4-Percent- Annual Chance | 2-Percent- Annual Chance | 1-Percent- Annual Chance | 0.2-Percent- Annual Chance |
| Flow Split to Baker Creek at North Diversion | 1,023 | 68,398 | 7,419 | 8,430 | 9,126 | 9,783 | 11,183 |
| Flow Split to Baker Creek at Moreland Ditch | 1,010 | 75,810 | 7,454 | 8,468 | 9,165 | 9,824 | 11,228 |
| Flow Split to Baker Creek Overflow South Cameron Bridge | 1,010 | 76,476 | 7,506 | 8,545 | 9,265 | 9,951 | 11,431 |
| Flow Split to Baker Creek Overflow South Cameron Bridge | 1,004 | 78,758 | 7,506 | 8,545 | 9,266 | 9,953 | 11,438 |
| Flow Split to Baker Creek Overflow South Cameron Bridge | 1,003 | 79,310 | 7,640 | 8,717 | 9,465 | 10,177 | 11,717 |
| Upstream Study Limits | 889 | 163,181 | 7,664 | 8,766 | 9,535 | 10,269 | 11,859 |
| West Gallatin East Overflow | | | | | | | |
| Upstream Study Limits | *1 | 3,667 | 221 | 256 | 293 | 341 | 592 |

*1 Data not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

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Hydraulic analysis of all the streams studied was complicated by the fact that once flow exceeded the capacity of the main channel, it usually dropped into one (or more) secondary channels or was lost to an entirely different channel or overflow area. This required the development of several independent water- surface profile computations to be made on each channel or overflow area. Discharge curves for over bank flow also had to be developed or estimated to determine the amount of flow that would transfer from one channel or flow area to another.

Composite discharge curves were developed combining channel discharge curves with over bank discharge curves or other channel curves. These composite discharge curves were used to determine flow losses or flow splits at points where channels separated or at points where water overtopped roads, railroads, levees, or natural banks.

Cross Sections

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the FIRM. Distances between cross sections are channel distances including meander lengths.

Bozeman Area

Cross sections presented in the original study were developed for East Gallatin River and Buster Gulch from topographic data (Reference 30). Underwater cross sections for East Gallatin River and Buster Gulch were obtained by field- surveying methods for every fifth cross section. Bridge and culvert data were gathered in the field by the NRCS in 1971. Supplemental field surveys were made in 1978 at critical locations to ensure accuracy.

Cross sections for the hydraulic analysis presented in the 2002 and 2007 Anderson re-studies for East Gallatin River were developed from the digital terrain model developed by photogrammetric methods from aerial photographs taken in September of 2001. This data was supplemented with field surveys at bridge locations.

West Gallatin River Area

Due to the braided nature of the stream channels on West Gallatin River, Baker Creek Area, Baker Creek West Overflow, Camp Creek, and Jefferson River, the distances

between cross sections do not necessarily follow a defined stream channel. Thus, the distances between cross sections for these streams, as measured on the FIRM, will not necessarily match the distances shown in the Floodway Data Table (FDT) referenced as Table 7 later in this report. This is due to the fact that the distances in the hydraulic model represent the flow path taken during the 1-percent-annual-chance flood event.

For the West Gallatin River, the area upstream of Cameron Bridge, cross sections were located by field surveys conducted by the NRCS in 1976 and 1977. These sections include bridge and culvert data. From Cameron Bridge to Interstate Highway 90, cross section data were developed from topographic data (Reference 31). Underwater sections were obtained by field-surveying methods for approximately every fifth cross section. In 1978, the NRCS gathered all bridge and culvert crossing data from field observations. Some supplemental field survey data were also gathered at critical overflow areas.

Three Forks Area

Cross sections for the Jefferson River were located by field surveys conducted by the NRCS in the spring of 1978. These sections include bridge, culvert, and approximately every third underwater channel section. The remaining cross sections were developed from topographic data (Reference 32). The basis of the topographic data was photographs taken in June 1977 (Reference 33). Field checks indicated that map accuracy was approximately 0.5 foot.

Cross sections for the Madison River were developed from the same topographic data used for Jefferson River. The NRCS conducted field surveys in the spring of 1978 to collect bridge, culvert, and underwater data for approximately every third cross section.

To route water on the west side of Madison River, a separate set of cross sections was developed and water-surface elevations were computed for the Old Town and Interstate Highway 90 interchange area northeast of Three Forks.

No profiles were developed for, Madison River and Jefferson River Overflow Area, Jefferson River Middle Channel, Jefferson River Easternmost Channel, and Overflow Area.

Cross section surveys of the underwater channel sections and bridges were obtained during the November 2002 to February 2003 period by Allied Engineering Services Inc (AES). The overbank portions of the cross sections were developed from topographic data prepared by David C. Smith and Associates (DSA). The basis of the topographic data was aerial photography taken November 15, 2002. Horizontal and vertical control was provided by AES by Global Positioning Survey (GPS) methods. Two-foot contour interval maps were prepared at a scale of 1:1200.

Water Surface Elevations

Water-surface elevations were determined using the HEC-RAS (Reference 38) and WSP-2 NRCS computer programs (Reference 39), which performs subcritical flow backwater computations by a modified step method. The program computes head losses at restrictive sections, including roadways, with either a bridge opening or culverts using the U.S. Bureau of Public Roads method (Reference 40).

Bozeman Area

For the extensions of Mathew-Bird, Figgins, and Nash-Spring Creeks, and the restudy of a portion of Mathew-Bird Creek, water-surface profile determinations were computed using the USACE HEC-2 water-surface profiles computer program.

Water-surface elevations computed for Bridger Creek, East Gallatin River, and Buster Gulch were checked against historical elevations and found to be consistent with the historical observations.

There were no elevations of record for the 1981 flood. The finished maps show this area to be in the 1-percent-annual-chance floodplain.

There was an elevation from the flood of 1997 that was estimated from a photograph in the Outlaw Subdivision along the East Gallatin River. This elevation was determined to be 0.15 feet higher than the predicted 10- percent- annual-chance flood event at this location. The recurrence interval for the 1997 event has been estimated at between 10- and 4- percent-annual-chance events.

In the 2002 Anderson re-study, the 1-percent-annual-chance elevations are about 2 feet lower than the original study. Much of this can be attributed to channel scour which lowered the channel bottom 2 to 2.5 feet though most of the reach. Bridge losses were computed by energy methods or by pressure and weir flow methods for submerged conditions.

West Gallatin River Area

Water-surface elevations computed for the main channel of West Gallatin River were checked against aerial photographs taken during high water. One set of photographs was taken by the MDNRC on June 18, 1974 (Reference 41).

Another set of photographs was taken by the USGS on June 11, 1970, during a peak flow of approximately one-half the 1974 flow (Reference 42). These aerial photographs were valuable in calibrating the water-surface computations and increasing the accuracy of the flood routing. Flood routing data correlated very closely with the historical data.

Up to four channels, or flood areas, were computed and used in combination to flood route the downstream portion of the study area for the West Gallatin River due to the complicated and divergent flow pattern that exists there. This flow pattern was developed by computing the amount of floodwater that overtops the west bank of the main channel of West Gallatin River at various points and routing it through a complex maze of channels on the west of the valley, including Baker Creek and Camp Creek. Once water leaves the main channel, it does not return within the study area. Instead, it flows north and west down Baker Creek and other channels, transferring back and forth across small ridges as these channels vary in size and capacity and as they intersect roads and other obstructions.

Three Forks Area

Water surface profiles were computed using the USACE computer program HEC-RAS. Steady State sub critical flow backwater computations were performed using the average conveyance method.

Water-surface elevations and flood boundaries for the Jefferson River were checked against documented information including aerial photographs taken during high water (Reference 37, 38, 39).

Starting Water Surface Elevations

Bozeman Area

Starting water-surface elevations for Bozeman Creek were determined assuming flooding to be occurring on East Gallatin River at the same time as flooding on Bozeman Creek. The slope-area method was used for determining starting water-surface elevations on East Gallatin River. Starting water-surface elevations on Bridger Creek were determined assuming flooding to be occurring on East Gallatin River at the same time as flooding on Bridger Creek. Starting water-surface elevations on Mill Ditch Diversion, Mathew-Bird Creek, and Nash-Spring Creek were taken from the completed profile on Bozeman Creek. Starting water-surface elevations for Figgins Creek were taken from the completed profile on Mathew-Bird Creek. Flat Creek starting water-surface elevations were computed using the completed profile of Mathew-Bird Creek with consideration of head loss through its downstream section.

Each of the three streams (Mathew-Bird Creek, Figgins Creek, and Nash-Spring Creek) studied in the revised portion of the FIS were extended to show detailed flooding to the extraterritorial jurisdiction limits of the City of Bozeman. These streams are located in areas which are or were once used for farmland or pasture. Reaches of these streams were channelized and/or realigned years ago to accommodate farming practices. The result in some cases is stream channels which may not follow the natural flow line of the topography. These streams and others not disturbed, have in some reaches limited capacity which results in large areas of shallow overbank flooding. This flooding was not a large problem when used for agricultural purposes and was part of the flood irrigation practice. However, now that these areas are being developed, the flooding characteristics have the potential to cause serious problems and damages.

The culverts on the restudy reach of Mathew-Bird Creek at Kagy Boulevard, Hoffman Drive, and Mason Street demonstrate the problems which can be created. The original stream channel in this reach had a substantial capacity. The existing culverts have approximately a 10-percent-annual-chance flood capacity. Flood events such as an 1-percent-annual-chance event are forced out of the channel at these road crossings and cause substantial shallow sheet flooding in the overbank areas. These overbank areas are fully developed.

The new study reach of Mathew-Bird Creek parallel to Sundance Drive has four small dams which increase the flood widths and depths in their immediate vicinity when compared to the undeveloped condition. These dams, however, do not have a significant effect on the 10-, 2-, 1-, and 0.2-percent-annual-chance flood events. Therefore, no indication of their existence is recorded anywhere else in the Flood Insurance Study.

The reach above the end of Sundance Drive and Goldenstein Lane includes a section of channel which was most likely relocated in the past. This reach is perched and floods greater than a 0.2-percent-annual-chance event will overtop the east bank and cause substantial sheet flooding in the east overbank area. There is one small dam on Nash-Spring Creek between the start of the study and Goldenstein Lane. This dam causes

a small backwater affect and interrupts the natural flow profile. However, like the four small dams on Mathew-Bird Creek, this dam has little significance and is not mentioned anywhere else in the effective FIS.

The Figgins Creek channel downstream of Kagy Boulevard has been relocated and joins Mathew-Bird Creek just above Hoffman Street. The culvert under Kagy Boulevard has a capacity less than a 10-percent-annual-chance event. This situation causes a large transfer of flow out of the channel and a substantial sheet flooding area. The channel and three private driveway crossings downstream of Kagy Boulevard have a capacity slightly less than the culvert at Kagy and cause additional transfer of flood flows to Hoffman Drive.

In the 2002 and 2007 Anderson studies, the USACE HEC-RAS computer model was used for the hydraulic computations. Starting elevations were determined by the slope-area method at cross sections downstream of the study area with slopes taken from the downstream studies.

West Gallatin River Area

The slope-area method was used for determining starting water surface elevations on the West Gallatin River, Baker Creek, and Camp Creek. Calculations were started downstream of U.S. Highway 10 so that the slope would normalize before reaching the study area. Starting water-surface elevations on Baker Creek West Overflow were determined assuming that flooding occurred on Camp Creek at the same time as flooding on Baker Creek West Overflow.

Three Forks Area

The slope-area method was used to determine starting water-surface elevations for the Jefferson River. Jefferson River is a braided river within the study area, so cross sections were broken into as many as four separate major channel segments to represent the different flow areas. Independent water-surface profile computations were made for each of these channel segments. The water-surface elevations, therefore, vary as one proceeds across any cross section from the main channel on the west across the secondary channels toward Three Forks.

Starting water-surface elevations for spring-runoff floods on the Madison River were determined using the slope-area method. Analysis showed that the spring flood flows did not produce elevations as high as ice jam floods in the study area. Therefore, flood elevations on Madison River were determined by assuming that winter ice jams would cause water to reach the top of the lower west side bank or levee. This can and has happened frequently.

Roughness Factors

Roughness coefficients (Manning's "n" values) for computations in the hydraulic analyses were calculated using known slopes and discharges from USGS gage measurements and by field observations of the stream and floodplain areas unless noted otherwise. These values were modified as channel vegetation or flow conditions changed.

Channel values ranged from 0.028 to 0.070 and overbank values ranged from

0.045 to 0.300. These more recent values are presented on Table 5, Manning's "n" Values.

Table 5. Manning's "n" Values

| <u>Stream Name</u> | <u>Roughness Coefficients</u> | |
|---------------------|-------------------------------|-------------------|
| | <u>Channel</u> | <u>Over banks</u> |
| Bozeman Creek | 0.035 to 0.065 | 0.045 to 0.150 |
| Bridger Creek | 0.050 to 0.070 | 0.100 to 0.300 |
| East Gallatin River | 0.045 to 0.050 | 0.055 to 0.095 |
| The Buster Gulch | 0.045 | 0.065 to 0.150 |
| West Gallatin River | 0.038 to 0.050 | 0.060 to 0.150 |
| Jefferson River | 0.028 to 0.040 | 0.050 to 0.300 |
| Madison River | 0.035 to 0.040 | 0.050 to 0.150 |

Shallow 1-percent-annual-chance flooding of the Madison River, less than 1 foot in depth, is prevalent in overland flow areas and along some roads near Three Forks. Overland and street flows were routed using Manning's equation to determine capacity of flow sections. Wherever possible, photographic documentation of street and yard flooding was used. This flooding is designated as the 1-percent-annual-chance shallow flooding on the FIRMs. For the Madison River, miscellaneous measurements were available at the old Highway 10 Bridge.

The degree of precision used to compute the flow separation depended on the data available and how critical it was to determine the actual extent of the flood plain. The hydraulic analysis for this study was based on unobstructed flow except on Madison River. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Levees

Located along the lower reach of the East Gallatin River are two uncertified levee systems. In accordance with Appendix H of the FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, two hydraulic models of the river were created. The first scenario was modeled as if the levees are in place and containing the flood flows. The second being modeled as if the levees failed.

In both levee locations, losses occurring from modeling the river without the levees created a situation where the water leaving the main channel and floodplain didn't return until downstream, outside the scope of this study. In these situations, losses were modeled using a lateral weir system and two new reaches were created, East Gallatin Overflow and East Gallatin Golf Course.

The first uncertified levee is located between sections BH and BJ, upstream of Manley Road. This levee is a primitive structure that appears to be created by pushing soil up into a berm shape. The losses from this area leave the right riverbank and head northwest through agricultural grazing areas. This area was modeled by the East Gallatin Overflow reach.

The second uncertified levee is located between sections AP and AS, just upstream of Springhill Road and directly adjacent to the Riverside Country Club. This levee was

created in the 1970's to protect the Country Club from flooding. The losses from this area leave the right riverbank and head north/northwest following the Springhill Road roadside ditches. This area was modeled by the East Gallatin Golf Course reach.

Madison River

The effects of ice jams dominate the Madison River flood profiles. The HEC- RAS model was used to determine the flood water levels from the winter ice jamming condition. These levels ranged from one to four feet higher than the open flow floods for the 1-percent-annual-chance event. These levels have been documented by past winter ice jam flood events. Additional discussion of the ice-jam analysis follows.

The left or west levee which extends through most of the study reach would be overtopped during the 1-percent-annual-chance ice jam event. The levee also has inadequate freeboard in several places during the 1-percent-annual-chance open flow event. The base flood elevations shown east (channel side) of this levee are assuming the levee does not fail. The 1-percent-annual-chance flood elevations shown west or outside of the levee assumes that the levee is not effective in containing the flow and has failed. The right levee is assumed to not fail since this condition creates a higher water surface in Three Forks than the failed condition. The floodway for the Madison River is based on the ice jam condition with the levees in place. The floodway was taken as the area between the levees except where the levees failed or were nonexistent.

Insufficient data was available involving ice-jam stages to determine ice-jam frequency directly from historical stage data. The indirect approach as described in the FEMA Guidelines (2002) under section F.4.2 was therefore used. The existing limited historical documentation for the reach and stream gage records upstream of the area supports the results of the indirect analysis.

Peak discharge-frequency data for the ice-jam season (January-March) was obtained from stream gage records using Bulletin 17B methods (see hydrology report). The ice-jam season is distinctly different and separate from the normal flood season which occurs in May and June.

The HEC-RAS ice-jam analysis was done on the entire study reach for both the with-levee and without-levee condition. The HEC-RAS geometry file was modified for the ice-jam condition by eliminating the small bridges on the multiple opening road sections. There was a difficulty getting convergence to a solution at these sections and it was determined that these minor bridges were not conveying a significant amount of discharge.

Ice jamming in the model was limited to the channel only. For much of the reach the channel section consists of several braided channels and the areas in between them. The overbank areas were modeled with an ice cover, but no jamming. Manning's "n" for the ice was initially allowed to vary within the model. However, this resulted in crossing of the multiple profiles and the values were then fixed based on the average results in the initial runs.

Although it is believed that grounding may occur for ice jams in the Madison River, that analysis was not used. The stages obtained with the floating-type jams agreed well enough with the historical data without the need to further obstruct the channel.

Ice jam stages for the 1-percent-annual-chance return period are three to four feet higher than free flow stages. Ice thickness ranged from five to ten feet. The observed water surface shown on the plots is the effective BFE inside the levee. It was taken as the top of the levee at the time of the study and was not necessarily a water surface.

Photographs of the 1978 flood show ice levels at the top of the levee to two feet below the top. The flood of 1972 had similar stages through the reach. An analysis of the ice stages at the stream gage upstream (06042500) for nine years of record showed the ice stage for a ten year event 4.5 feet above the stage of open flow for that frequency (see hydrology documentation). The Ice stage for the 1-percent-annual-chance level runs between one-half and one foot above the 10-percent-annual-chance stage. All of this supports the modeling, which shows the three to four feet difference between ice and open flow stages.

Based on the record at the Madison stream gage, ice-jam floods occurred four years out of nine or 44 percent of the time. This agrees with other stream gages in the area that show high ice stages from 40 to 50 percent of the years. Equation (3) as shown in the Guidelines was used to combine the stage probability curves for the ice-jam and open flow seasons. Because of the large difference between the ice stage and open flow stage the probability of exceeding a given ice-jam stage with free-flow conditions, either in the ice-jam season ($p(s_{oj})$), or during the free-flow season ($p(s_{of})$) are both nearly zero. Therefore equation (3) becomes $P(s) = P(s_{of}) * P(s_i = \text{ice jam event})$, where $P(s_{of})$ is the probability of the ice-jam stage and $P(s_i = \text{ice jam event})$ is the probability of having an ice-jam in any particular year (for our case .44).

Jefferson River

The flow splits on the Jefferson River just upstream of old Highway 10. At discharge exceeding about 15,500 cfs (10-percent-annual-chance flood) flow overtops the normal banks and part of it flows to the east. From there it can enter Three Forks in the southwest corner of the city. During the 1-percent-annual-chance flood the amount flowing east was determined to be about 1,900 cfs or about 8 percent of the total storm flow. The split flow is added back to the main flow at the appropriate locations and was not routed separately through the city area because the highway and railroad embankment was not considered as an effective barrier. The area south of old US 10 is outside of the study area and was not mapped.

The Milwaukee Railroad embankment was not considered as an effective barrier to flow for this study. The embankment was ignored for the hydraulic modeling through Three Forks.

However, for that area north of Three Forks, and upstream of Interstate 90, the area to the right (east) of the railroad embankment was considered as ineffective flow due to the blockage and ponding caused by the highway. Ice was determined not to be a controlling factor for the Jefferson River flood stage. Ice jams at the stream gage show a lower stage than open flow floods of a like frequency. Historical records also support this, since no significant damage has resulted from ice jam flooding on the Jefferson River.

This Revision to the Countywide:

Bozeman Creek Watershed

Hydraulic modeling was performed using HEC-RAS version 4.1.0 (Reference 32). Cross Sections were cut and terrain data was transferred from GIS using HEC-GeoRAS version 10 (Reference 33). All culverts, bridges, and inline structures were modeled in accordance with the HEC-RAS User's Manual, Version 4.1 (Reference 34). In addition, standards listed in FEMA's Knowledge Sharing Site (KSS) (Reference 35) were followed to ensure the study meets industry standards.

Four model plans were set up for various purposes. The plan titled "Bozeman Flow Calculations" uses discharges from the hydrologic analyses for the primary flooding sources, and optimized lateral weirs to determine the magnitude of each split flow and was used to develop the workmaps.

Field survey and topographic information was collected using the methods and procedures outlined in Appendix A (Aerial Mapping and Surveying) of FEMA's Guidelines and Specifications (Reference 44).

Terrain data was collected on April 18, 2013, for the entire study footprint area in the form of Light Detection and Ranging (LiDAR) points by Photo Science, Inc. (Reference 10). The data was calibrated and checked by Gaston Engineering. The LiDAR deliverables included digital elevation models (DEM) (1-meter resolution), 1-foot contours, and a report documentation among other items.

The data exists in the following projection and datum:

| | | |
|-------------|---|--------------|
| Projection: | Montana State Plane | <u>Units</u> |
| Datum: | Horizontal – MT 2500 St Pl NAD83 (2011) | Feet |
| | Vertical – NAVD88, Geoid 12A | Feet |

The LiDAR DEM (1-meter resolution) was the primary topographic source for the project and was used to develop the HEC-RAS cross-sections.

Bathymetric data collection was necessary to supplement the LiDAR data since the streams are detailed study reaches which require a higher level of data inputs to achieve better modeling results. Also, detailed hydraulic analyses also require that all structures be included in the modeling unless it can be shown that the structure is not hydraulically significant to the model results. Therefore, field survey was collected.

Ground survey was collected for select riverine cross sections and all hydraulic structures between October 2012 and January 2013 by Allied (Reference 11). Channel cross-sections were taken at approximate maximum 1,000 foot intervals. In total, 500 cross sections and 219 structures were surveyed.

Due to the limited capacity of the primary flooding sources, there are numerous split flows that leave main channels and become flooding sources unto themselves. Some splits only leave during extreme flood events, but others can be expected with some regularity. Each flow where a significant amount of flow (more than 10 cfs) would leave the main channel was modeled. (Flow may split in other locations, but will likely be either low discharge or less than 0.5 feet deep). The table below lists each of these flow splits and gives information on how each is expected to form.

Bozeman Creek Watershed, List of Flow Splits Descriptions

| Split Flow Name | Splits from | Description | Stream Length (miles) |
|-----------------------------|----------------------|--|------------------------------|
| 3 rd /Kagy Split | Figgins Creek | Splits from Figgins Creek upstream of the 3 rd Avenue Culvert. Heads north along 3 rd Avenue, bends east on Kagy Boulevard, and rejoins Figgins Creek | 0.2 |
| Black Avenue Split | Flat Creek | Some flow along Flat Creek overtopping the road at Black Avenue splits and continues along Black Avenue. Flow heads northeast and north before joining Garfield Street Split | 0.6 |
| Cedar Street Split | Mill Ditch Diversion | Splits from Mill Ditch Diversion upstream of Cedar Street. Flows to the northwest adjacent to Cedar Street, before crossing at a low point along Cedar Street and returning to Mill Ditch Diversion | 0.2 |
| Church Avenue Split | Bozeman Creek | Exists Bozeman Creek at Olive Street heading west. Bends north on Church Avenue and continues on Church Avenue before returning to Bozeman Creek | 0.6 |
| Flat/Kagy Split | Flat Creek | Splits from Flat Creek upstream of Kagy Boulevard and heads northwest parallel to Kagy before joining Mathew-Bird Creek | 0.1 |
| Gallagator Split | Bozeman Creek | Splits from Bozeman Creek upstream of Gallagator Trail and heads northeast parallel to the Gallagator Trail before joining Mill Ditch Diversion | 0.1 |
| Garfield Street Split | Mathew-Bird Creek | Some flow along Mathew-Bird Creek overtopping the road at Garfield Street splits and continues along Garfield Street to the east. Bends north at Bozeman Avenue, then east on Cleveland Street before joining Rouse Avenue Split | 0.3 |
| Golf Course Split | Nash Spring Creek | Flow gradually departs Nash Spring Creek through and goes through the golf course before joining Flat Creek upstream of Kagy Boulevard | 0.3 |
| I-90 Split | Mill Ditch Diversion | Flow splits from Mill Ditch Diversion upstream of I-90 and heads northwest parallel to I-90. Crosses under I-90 at L street and spreads out heading north before joining East Gallatin River | 0.7 |
| Kagy/Rouse Split | Golf Course Split | Some flow along Golf Course Split overtops Kagy Boulevard and heads north. Some flow | 0.1 |

Bozeman Creek Watershed, List of Flow Splits Descriptions

| Split Flow Name | Splits from | Description | Stream Length (miles) |
|------------------------|-----------------------|---|------------------------------|
| | | joins Rouse Avenue Split to the northwest and some rejoins Bozeman Creek to the northeast | |
| Lower Black Split | Garfield Street Split | Some flow on Garfield Street Split bends north onto Black Avenue. Some of this flow returns to Mathew Bird Split and some continues to join Rouse Avenue Split | 0.2 |
| Mill/Railroad Split | Mill Ditch Diversion | Flow on the left overbank of Mill Ditch Diversion splits and crosses railroad tracks before rejoining Mill Ditch Diversion downstream. This split is not significant for flows with a 1-percent-annual chance recurrence interval or less. | 0.2 |
| Museum Split | Figgins Creek | Flow splits from Figgins Creek upstream of the trail embankment, heading north alongside the embankment before crossing it at a low point and returning to Figgins Creek | 0.3 |
| Nash Road Split | Bozeman Creek | Flow on the left overbank of Bozeman Creek splits across farmland before crossing Nash Road at a low point and continuing north before rejoining Bozeman Creek | 0.4 |
| Peace Pipe Split | Mathew Bird Creek | Flow splits from Mathew Bird Creek to the right along Peace Pipe Drive. It continues along Peace Pipe Drive for approximately 600 feet before finding a low point and moving north through a residential area, before returning to Mathew Bird Creek. This split is not significant for flows with a 1-percent-annual chance recurrence interval or less. | 0.5 |
| Rain Roper Split | Mathew Bird Creek | Flow on the right overbank leaves Mathew Bird Creek downstream of Peace Pipe Drive and continues north, parallel to Rain Roper before rejoining Mathew-Bird Creek | 0.2 |
| Rouse Avenue Split | Flat Creek | Some flow along Flat Creek overtopping the road at Black Avenue splits and continues along Rouse Avenue Flow heads north before joining Bozeman Creek | 0.8 |
| Sourdough Trail Split | Bozeman Creek | Flow in the left overbank of the Bozeman Creek splits to the left upstream of a private driveway and heads north before joining Nash Spring Creek | 0.3 |
| Tracy Avenue Split | Figgins Creek | Flow in the left overbank of Figgins Creek splits to the north upstream of Hoffman Drive | 0.2 |

| Bozeman Creek Watershed, List of Flow Splits Descriptions | | | |
|--|---------------------|---|------------------------------|
| Split Flow Name | Splits from | Description | Stream Length (miles) |
| | | and continues along Tracy Avenue northward before joining Mathew-Bird Creek | |
| Wallace Avenue Split | Church Avenue Split | Some flow on Church Avenue Split splits to the east on Main Street and bends to the north on Wallace Avenue, heads north and returns to Bozeman Creek | 0.9 |

Black Avenue Split and Rouse Avenue Split – Due to the unique physical circumstances at this flow split location, lateral weirs were not used. Flow along Flat Creek that does not fit in the culvert at Black Avenue overtops the road at a high point. Half the overtopping flow can be expected to head in each direction. Therefore, the flow overtopping the road was evenly divided between these two flooding sources. This is a more reasonable representation of how the flow would split than the use of a lateral weir would be at this location.

Bozeman Creek – Flow that leaves Bozeman Creek at Goldenstein Lane and the Sourdough Trail Split goes through the large network of splits in the vicinity of Kagy Boulevard before gradually returning, split by split, to Bozeman Creek. In general, conservative assumptions were made as to when the flow returns to Bozeman Creek in this area. For example, when flow enters Bozeman Creek from Rouse Avenue Split at Cross Section 13969, all flow that left Bozeman Creek at Goldenstein Lane or via Sourdough Trail Split is assumed to have returned. Also, a significant portion of flow along Mathew Bird Creek will enter Bozeman Creek at this location. Therefore, the flow at this location is equal to the flow from the hydrology report “Bozeman Creek at Olive Street”, even though Olive Street is some distance downstream of this point.

Church Avenue Split – As flow goes north along Church Avenue, it gradually splits to both the east (towards Wallace Avenue split) and the west (towards Bozeman Creek) along the crossing east-west roads. These flow transfers were modeled and calculated simultaneously using lateral weirs on both sides of Church Avenue Split.

Flat Creek at confluence with Golf Course Split – Flow that joins Flat Creek from Golf Course Split greatly overwhelms any flow coming from the upper reaches of Flat Creek. Golf Course Split will have its greatest peak discharges during Bozeman Creek flooding events, which are unlikely to occur simultaneously with Flat Creek flooding events. Therefore, flow that originates in the Flat Creek watershed is assumed to be zero when the Golf Course Split is at its peak.

Flat Creek at Hoffman Drive – The effective map shows Flat Creek ending at Hoffman Drive as a result of an inlet to the City’s storm sewer system. However, a review of the sewer system revealed that the inlet and pipe is not adequately sized to be able to handle all the flows along Flat Creek. (The storm sewer system has a 21” diameter pipe;

insufficient to handle the flows given the great increase of discharge on Flat Creek caused by flows delivered from Bozeman Creek via Sourdough Trail Split, Nash Spring Split, and Golf Course Split). However, downstream of Hoffman Drive, the 1-percent annual chance flood event is less than 1 foot in average depth, so is mapped as X-shaded.

Garfield Street Split – Peak flows on Garfield Street Split occur during flooding originating in the Mathew Bird Creek watershed. Because the flood peaks at a different time, flow on Black Avenue Split will be minimal during flooding on Garfield Street Split. Therefore, flow from Black Avenue Split is not added on to the peak flows on Garfield Street Split.

Lower Black Split – Peak flows on Lower Black Split occur during flooding originating in the Mathew Bird Creek watershed.

Mathew-Bird Creek at Kagy Boulevard – Mathew Bird Creek accepts flow that originates from splits ultimately fed by Bozeman Creek in the Flat/Kagy Split. However, peak flows on Bozeman Creek are unlikely to be significant at the same time as peak flows are occurring on flow that originates in the Mathew-Bird Creek watershed. Peak flows that originate in the Mathew Bird watershed dominate at all cross sections.

Mathew Bird Creek at Figgins Creek and Tracy Avenue Split – Flow from Figgins Creek will enter Mathew Bird Creek both at the confluence with Figgins Creek and at the confluence with Tracy Avenue Split. Given the uncertainty in the flow split, Mathew Bird Creek is modeled conservatively to assume that all flow from Figgins Creek enters Mathew Bird Creek at the confluence with Figgins Creek.

Mill Ditch Diversion at diversion structure – Lateral structure calculations reveal that approximately 45 cfs will split from Bozeman Creek in the vicinity of the Mill Ditch Diversion structure during the 1-percent-annual chance flooding event. This is significantly lower than the 340 cfs on Mill Ditch Diversion presented in the effective study. It appears that the effective study is in error. The right overbank of Bozeman Creek in this area is relatively high, which doesn't allow much flow to overtop into Mill Ditch Diversion. The structure itself has a relatively small opening (3' x 2.5'), which can only pass a limited amount of flow. Additionally, given the relatively flat slope of Mill Ditch Diversion in this area, backwater limits the amount of flow that splits. All of this taken into account, 45 cfs in Mill Ditch Diversion at this location is reasonable.

Mill Ditch Diversion at diversion structure – The 2-percent-annual-chance and 1-percent-annual chance are the same at this location. It is reasonable that these discharges would be similar given the size of the diversion structure and the fact that it is largely limited by backwater.

Mill Ditch Diversion at South Church Avenue – During the 0.2 percent-annual-chance event, flow at this location splits back across the Gallagator Trail to Bozeman Creek. This is caused by an undersized culvert at South Church Avenue. This demonstrates that even if the Mill Ditch Diversion structure size was increased, flow along Mill Ditch Diversion would still be limited by this structure.

Mill Ditch Diversion – In the Mill Ditch Diversion hydrologic analysis report, it clearly states that the greater of two discharges should be used – flow that originates in the Mill Diversion Ditch watershed, or flow that splits from Bozeman Creek. For the reach identified in the hydrologic report as “at Main Street”, the discharges originating from

the Mill Ditch Diversion dominate for the 10- and 0.2-percent-annual-chance event, while the flows splitting from Bozeman Creek dominate for the 4-, 2-, 1-percent-annual-chance event. For the reach identified in the hydrologic report as “upstream of Northern Pacific Railroad” (and downstream), the flow that originates in the Mill Ditch Diversion watershed dominates for all recurrence intervals.

Mill/Railroad Split – According to the lateral weir calculations, discharges to Mill/Railroad Split will be less than 2 cfs during the 1-percent-annual chance flood event. This is not a significant amount of flow. Therefore, Mill/Railroad Split is considered to be a split during the 0.2-percent-annual chance event only, and is mapped as Zone X shaded.

Nash Spring Creek at Goldenstein Lane – Some flow splits from Bozeman Creek toward Nash Spring Creek at Goldenstein Lane. However, flow peaks on Bozeman Creek and Nash Spring Creek do not occur at the same time. Peak flows on Nash Spring Creek between Goldenstein Lane and the confluence with Sourdough Trail Split are caused by floods originating in the Nash Spring Creek watershed.

Nash Spring Creek downstream of Sourdough Trail Split - Peak discharges are influenced by the combined flow that originates in the Nash Spring Creek watershed, and the flow from Sourdough Trail Split (which originates from Bozeman Creek). The maximum peak discharges on Nash Spring Creek downstream of Sourdough Trail Split are attained during the maximum flow on Bozeman Creek. According to data interpolated from the hydrologic analysis, while Bozeman Creek is peaking, flows originating on Nash Spring Creek are at between 58% (for the 10- percent) and 27% (for the 0.2- percent event) of their maximums. The peak Sourdough Trail Split flow and this percentage of the Nash Spring Creek flow are added together to calculate total peak flows in this area.

Rouse Avenue Split – The upper reaches of Rouse Avenue Split are fed by flows from Flat Creek (flows that originate in the Bozeman Creek watershed). However, peak flows downstream of the confluence with Garfield Street Split are dominated by flows from Garfield Street Split, which originates in the Mathew Bird Creek watershed.

The reach boundary conditions were set using normal depth water surface elevations for all the primary flooding sources in this study. The slope was calculated based on the slope of the channel in the vicinity of the most downstream cross section. For the split flow flooding sources, boundary condition was set either using a junction or known water surface elevation (if the timing of the peak is the same for the split as for the receiving flooding source), or using normal depth (if the timing of the peak of the split is not the same as the receiving flooding source).

Manning’s roughness coefficients (Manning’s ‘n’ values) were determined based on aerial imagery and photographs provided by the Allied Engineering Surveyors. For channel areas, Manning’s ‘n’ values were set to 0.045 for most cross sections. This is indicative of a clean, winding channel with some weeds and stones. At other cross sections, Manning’s ‘n’ values were higher, indicative of timber or brush in the channel. For flooding sources that run along roadways, Manning’s ‘n’ values were set to 0.016, indicative of rough asphalt.

Manning’s ‘n’ values for overbank areas were more variable, to account for different land uses and vegetation growth. At some cross sections, overbank Manning’s ‘n’ values were as low as 0.040, indicative of grassy yard or pasture areas, or cultivated areas with field crops. At other cross sections, Manning’s ‘n’ values were set higher, indicative of brush,

trees, and undergrowth. At some cross sections, Manning's 'n' values were elevated somewhat higher than the vegetation would indicate to account for other obstructions in the floodplain, such as buildings, garages, or sheds. Table below provides a summary of the range of Manning's 'n' values used for this watershed.

| Land Use and Description | Range of Manning's 'n' Values |
|--|--------------------------------------|
| Channel – Winding with some weeds and stones | 0.045 |
| Channel – Winding with more weeds, brush, or trees | 0.050 – 0.080 |
| Channel – Street flow on asphalt | 0.016 |
| Overbanks – grassy areas | 0.040 – 0.060 |
| Overbanks – farmed/cultivated areas | 0.040 – 0.060 |
| Overbanks – brush, trees, other obstructions | 0.060 – 0.080 |
| Overbanks – low density development | 0.045 – 0.080 |

Cross sectional geometries were established based on the geometry of both the 2013 LiDAR and the 2012-2013 field survey. Cross sectional geometries were first taken from the LiDAR using HEC-GeoRAS, version 10 (Reference 33). At locations where cross section survey was collected, the survey data was superimposed on the cross section at the appropriate location using manual methods.

At cross section locations along the primary flooding sources where survey data not collected, bathymetric cross section geometry was interpolated between adjacent surveyed cross sections.

For cross sections on the secondary or split flow flooding sources, cross sectional geometries were determined using the LiDAR terrain data only. Given that these flooding sources did not contain water when the LiDAR was collected, bathymetric or survey data would not improve the modeling geometries. Therefore, survey was not collected or used in the model for these flooding sources.

Cross section locations were set using established engineering practice and guidance provided in the HEC-RAS Hydraulic Reference Manual. Several cross sections were modified using the skew adjustment in HEC-RAS. All total, there are 1,047 cross sections in the hydraulic model, across approximately 28 miles of detailed study. This averages out to approximately one cross section every 140 feet.

Contraction and expansion coefficients were set as recommended in the HEC-RAS Hydraulic Reference Manual – 0.3 and 0.5 in cross sections adjacent to hydraulic structures, and 0.1 and 0.3 in cross sections that are not adjacent to hydraulic structures. There are a handful of other cross sections that are not adjacent to hydraulic structures where higher expansion and contraction coefficients are used. These are indicative of rapid contraction or expansion caused by natural land features or man-made embankments.

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Structure geometries were taken from the collected survey data. The photographs, sketches, and spatial data in GIS were all used to most reasonably and accurately model the geometry of each individual hydraulic structure.

Low flow and high flow structure modeling approaches were all determined in accordance with guidance provided in the HEC-RAS Hydraulic Reference Manual. Due to practical spacing limitations, not all hydraulic structures have the standard 4-cross section contraction and expansion placements recommended in the Hydraulic Reference Manual. However, for many structures, cross section 1 and 4 of the recommended approach are not necessary. For example, in the instance of small footbridges that overtop easily, distinct contraction and expansion reaches do not exist in the traditional way. In these areas, the cross section associated with the next upstream or downstream structure is sufficient as a stand-in for the traditional cross section 1 or 4.

Ineffective areas and blocked obstructions were used in the model to restrict flows to areas of cross sections capable of actively conveying flow. Ineffective flow areas were used to model several different hydraulic scenarios:

In the vicinity of hydraulic structures, ineffective areas are used in areas that would not actively convey flow due to being blocked by the abutments or the approach to the structure itself. These ineffective areas were placed in accordance with structure modeling guidance provided in the HEC-RAS Hydraulic Reference Manual.

For hydraulically disconnected regions, ineffective areas were added to the model to account for the fact that flow would not be actively conveyed in these areas.

In overbank areas where flow during flooding events would be minor or insignificant, ineffective areas were used to ensure that accurate hydraulic calculations were taking place in the active, more significant flowpaths. This type of area tended to be a location where flow would not significantly penetrate, such as locations where flow to the lower

overbank areas would be mostly blocked by high ground or an embankment near to the bank station.

Areas of backwater were modeled as ineffective flow. Areas where the flow would be predominately lateral to the primary direction of flow were modeled as ineffective flow areas. One example of this would be at a cross section where a lateral incoming ditch was picked up along the cross section from the terrain data. These areas of lateral flow would not convey flow effectively in the primary flow direction during a flooding event.

Areas near buildings (or in the hydraulic “shadow” of buildings) were occasionally modeled as ineffective areas. This is done to account for areas of flow that would not be active to do the blockage caused by nearby buildings.

West Gallatin River

This study also update approximately 30 miles of the West Gallatin River, beginning at the confluence with the East Gallatin River and extending approximately four river miles above the community of Gallatin Gateway, Montana (Reference 1) . Appendix C of FEMA Guidelines and Specifications (FEMA 2009) was used as a guide for the West Gallatin hydraulic model development. The water surface elevations (WSEL's) were calculated with HEC-RAS, Version 4.1.0 hydraulic modeling software (USACE 2010). Cross sections were placed with ArcMap 10.1 (ESRI 2012) at locations where bathymetric surveys were completed and at structure locations along the floodplain. HEC-RAS for steady flow analysis, performs the standard step energy balance calculation between cross sections, starting at the most downstream cross section and moving upstream for a fully subcritical analysis.

Through the development of the hydraulic model, it was confirmed that floodwaters are directed throughout the floodplain through irrigation ditches and secondary channels away from the parent channel. In the event that the separated flow would not reconnect to the original stream channel within a distance of one mile, a new profile baseline was established. Junctions and lateral weirs were defined to model the flow split and a secondary flow path that would be created. Utilizing the flow optimization routine within HEC-RAS, the discharge split across the junction and lateral weirs was calculated ensuring that conservation of mass was balanced across the system while also balancing the energy equation. Lateral weirs were specified as a broad crested weir and utilize a weir coefficient of 0.5. In general, lateral weir coefficients should be lower than typical values used for inline weirs. The lower weir coefficients value is due to the energy/momentum loss associated with the turning flow lines from their downstream orientation to a lateral direction out of the river/reach (RAS Solution 2013). The discharge determined over each weir was calculated using the optimization routine within HEC-RAS.

Topographic survey data was completed in 2013 under Phase I of the project by Photo Science, Inc. in conjunction with Gaston Engineering & Surveying, PC. Phase I included discovery, along with acquisition and processing for 50.7 square miles of LiDAR data along with project corridor as well as bathymetric survey of the stream channel (Photo Science 2013 and Gaston 2013).

The field survey completed by MMI in the fall of 2014 (MMI 2015) included structure surveys for approximately 172 hydraulic structures (bridges, culverts, diversions, etc.) and site visit assessments of 50 additional structures.

State plane coordinates used for this survey are referenced to the Montana Coordinate System, North American Datum of 1983 (NAD83-2011). Elevations are referenced to the North American Vertical Datum of 1988 (NAVD88). Units are reported in International feet. GNSS-derived orthometric heights (elevations) were computed using Geoid 12A. These datum and units are identical to those used for the LiDAR calibration control points previously established in the Phase 1 portion of this project.

The roughness data were evaluated at each cross-section in HEC-RAS and adjustments to the horizontal limits were made to fit with the terrain data represented by the cross section. Adjustments to the roughness values were also made as needed during hydraulic model development. The adjustments to the HEC-RAS roughness values remained within the range of acceptable values determined for each land class. Roughness coefficients are provided in the Table below.

| Flooding Source | Channel “n” | Overbank “n” |
|---------------------------------|-------------|--------------|
| West Gallatin River | 0.038-0.040 | 0.055-0.10 |
| Baker Creek Split | 0.040 | 0.055-0.080 |
| Baker Creek Overflow Split Flow | 0.040 | 0.055-0.080 |
| East Overflow Split Flow | 0.040 | 0.055-0.080 |
| I-90 Diversion Split Flow | 0.055-0.080 | 0.055-0.080 |
| I-90 Lateral Split Flow | 0.053-0.055 | 0.055-0.080 |
| Linney Road Split Flow | 0.040 | 0.055-0.080 |
| Moreland Ditch Split Flow | 0.040 | 0.055-0.080 |

Split Flow Analysis

There are four flow scenarios occurring throughout the West Gallatin River floodplain. With the development of the hydraulic model and review of the initial results, locations were identified in which discharge overflowed the one or both banks of the channel or via a diversion structure so the resultant overflow would be directed away from the parent West Gallatin River channel. In the event that the separated flow would not reconnect to the original stream channel within a distance of one mile, a new profile baseline for the overflow channel was established. Junctions and lateral weirs were defined to model the flow split and the secondary flow path that would be created. Utilizing the flow optimization option within HEC-RAS, the discharge split across the junction and lateral weirs was calculated ensuring that conservation of mass was balanced across the system while also balancing the energy equation. Lateral weirs were also specified as a broad crested weir and utilized a weir coefficient of 0.5. In general, lateral weir coefficients should be lower than typical values used for inline weirs. The lower weir coefficients value is due to the energy/momentum loss associated with the turning flow lines from their downstream orientation to a lateral direction out of the river/reach (RAS Solution 2013). The discharge determined over each weir was calculated using the flow optimization option within HEC-RAS.

Given the complex nature of the West Gallatin River watercourse, a systematic approach was developed to the optimization process in order to properly calculate the split discharges across the lateral weirs and junctions. There are points of divergence within split flow system which are dependent upon the separation of discharges located further upstream. This flow divergence from the West Gallatin River commences approximately

one-half river mile upstream of the Cameron Bridge Road crossing and was modeled with lateral weirs conveying flow from the west bank to the Baker Creek Overflow Channel. The next downstream divergence is located at the Moreland Ditch diversion structure upstream and adjacent to the Cameron Bridge Road. This flow diversion was modeled with the inline structure feature to calculate the hydraulics of the vertical lift slide gates associated with this structure. The following sections describes the four flow scenarios that were developed to the optimization process in order to properly calculate the split flow discharges.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM have been converted to NAVD88. Elevations were established by GPS methods. Additional elevation reference marks were set at convenient locations in the study area. Table 6 shows individual datum conversion factors for each stream studied in this community.

Table 6. NGVD29 to NAVD88 Conversion Factors

| Stream Name | Conversion from NGVD29 to NAVD88 (feet) |
|-----------------------------------|---|
| Baker Creek Area | +3.59 |
| Baker Creek West Overflow | +3.61 |
| Bozeman Creek | +4.06 |
| Bridger Creek | +3.94 |
| Buster Gulch | +3.79 |
| Camp Creek | +3.51 |
| East Gallatin River | +3.88 |
| Figgins Creek | +4.03 |
| Flat Creek | +4.03 |
| Jefferson River | +3.39 |
| Gallatin River West Fork -Big Sky | +4.69 |
| Madison River | +3.39 |
| Mathew-Bird Creek | +4.05 |
| Mill Ditch Diversion | +3.96 |
| Nash-Spring Creek | +4.08 |
| West Gallatin River | +3.80 |

These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD29 and NAVD88, or to obtain current elevation, description, and/or location information for benchmarks shown on this map, visit the National Geodetic Survey

website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

There was an elevation from the flood of 1997 that was estimated from a photograph in the Outlaw Subdivision along the East Gallatin River. This elevation was determined to be 0.15 feet higher than the predicted 10-percent- annual-chance flood event at this location. The recurrence interval for the 97 event has been estimated at between 10- and 25-years, so this elevation verifies the study at this location.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent- annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (Reference 30, 31, and 36) and developed photogrammetrically, using aerial photographs at a scale of 1:4,800 (Reference 37).

On the FIRM, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual- chance floodplain boundaries are close together, only the 1-percent-annual- chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations, but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Flood boundaries of the 1- and 0.2-percent-annual-chance floods along the East Gallatin River and Buster Gulch have been delineated using aerial photographs taken in September 2001 and digitized topographic maps developed at 1:6000 with contour intervals of two feet.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain unless otherwise noted. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are presented on Table 7, "Floodway Data". In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

In Montana, the designated floodway is developed using a 0.5-foot surcharge instead of the Federal maximum of 1.0 foot (Reference 43). These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations, 24 CFR, 1910 (d). The floodways computed for this study are based on a maximum increase of 0.5 foot.

The floodways for, Baker Creek, Baker Creek West Overflow, and Camp Creek were made equal to the identified 1-percent-annual-chance flood plain. This was due to the complicated and divergent flow pattern that exists in this area. Anything that might be built or altered within this complex flow system could drastically affect the amount and depth of flow at points downstream. This means that any floodway that might be computed which would allow encroachment into any presently identified flow area could cause more than just an increase in the floodwater elevation at that point. It could also cause a change in the flow pattern and the flood hazard downstream. Therefore, to avoid this possibility, it was determined that the floodway and the identified 1-percent-annual-chance year flood plain should be equal.

Floodway widths for the Jefferson River (computed to include various high ground "islands" within the floodway) and for the West Gallatin River, Baker Creek Area, Baker Creek West Overflow, and Camp Creek were computed at locations which do not necessarily match cross section locations as shown on the FIRM (Exhibit 1); for this

reason, floodway widths, as shown on the Floodway Data Table (Table 7) will not necessarily agree with map floodway widths.

No floodway data for West Gallatin River Overflow Area, Madison River and Jefferson River Overflow Area, Jefferson River Middle Channel, and Jefferson River Easternmost Channel and Overflow Area are presented because only main channel areas have computed floodway data.

The Madison River floodway was determined to stay within the present levees. The floodway for Jefferson River, including its various secondary channels between U.S. Highway 10 and Interstate Highway 90, was computed by reducing the conveyance on the right-hand flood plain area of Jefferson River west of the City of Three Forks. The conveyance on this side of the flood plain was reduced until an average elevation rise of 0.5 foot in the water surface was achieved or the bank of the first secondary channel was reached, whichever occurred first. Downstream of Interstate Highway 90, the floodway was computed using equal- conveyance reduction.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation of the base flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

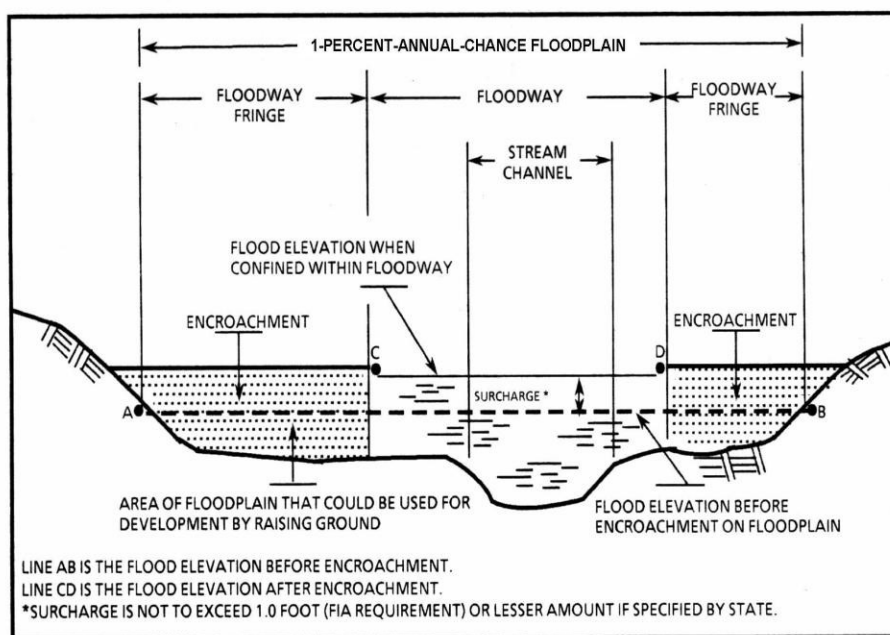


Figure 1. Floodway Schematic

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|--|--------------|--|---------------------------------|--|---------------------------|------------------------|----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE FEET) |
| A | 1,079 | 142 | 44 | 3.3 | 4,911.0 | 4,911.0 | 4,911.0 | 0.0 |
| B | 1,324 | 39 | 42 | 3.4 | 4,913.3 | 4,913.3 | 4,913.3 | 0.0 |
| ¹ Feet above confluence with Figgins Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | 3RD AVENUE - KAGY BOULEVARD SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Baker Creek West Overflow | | | | | | | | |
| A | 330 | 128 | 217 | 2.1 | 4,304.7 | 4,304.7 | 4,304.7 | 0.0 |
| B | 1,580 | 365 | 310 | 1.5 | 4,306.9 | 4,306.9 | 4,306.9 | 0.0 |
| C | 3,280 | 815 | 460 | 1.0 | 4,311.6 | 4,311.6 | 4,311.6 | 0.0 |
| D | 3,780 | 662 | 487 | 0.9 | 4,312.3 | 4,312.3 | 4,312.3 | 0.0 |
| E | 5,140 | 1,825 | 407 | 1.1 | 4,317.9 | 4,317.9 | 4,317.9 | 0.0 |
| F | 6,080 | 1,495 | 420 | 1.1 | 4,321.0 | 4,321.0 | 4,321.0 | 0.0 |
| G | 7,220 | 957 | 272 | 1.7 | 4,326.2 | 4,326.2 | 4,326.2 | 0.0 |
| H | 7,860 | 927 | 266 | 1.7 | 4,327.9 | 4,327.9 | 4,327.9 | 0.0 |
| I | 9,380 | 810 | 430 | 1.1 | 4,334.1 | 4,334.1 | 4,334.1 | 0.0 |
| J | 10,220 | 520 | 412 | 1.1 | 4,338.3 | 4,338.3 | 4,338.3 | 0.0 |
| K | 11,420 | 996 | 399 | 1.1 | 4,342.0 | 4,342.0 | 4,342.0 | 0.0 |
| L | 12,220 | 1,440 | 2,834 | 0.1 | 4,348.5 | 4,348.5 | 4,348.5 | 0.0 |
| M | 12,920 | 1,216 | 281 | 1.1 | 4,351.3 | 4,351.3 | 4,351.3 | 0.0 |
| N | 13,820 | 560 | 249 | 1.2 | 4,358.1 | 4,358.1 | 4,358.1 | 0.0 |
| O | 14,670 | 415 | 236 | 1.5 | 4,363.1 | 4,363.1 | 4,363.1 | 0.0 |
| P | 16,030 | 1,447 | 782 | 1.2 | 4,368.4 | 4,368.4 | 4,368.4 | 0.0 |
| Q | 16,590 | 715 | 686 | 2.2 | 4,372.0 | 4,372.0 | 4,372.0 | 0.0 |
| R | 17,350 | 920 | 987 | 1.5 | 4,376.7 | 4,376.7 | 4,376.7 | 0.0 |
| S | 18,390 | 698 | 776 | 1.9 | 4,382.5 | 4,382.5 | 4,382.5 | 0.0 |
| T | 20,170 | 967 | 915 | 1.6 | 4,389.9 | 4,389.9 | 4,389.9 | 0.0 |
| U | 21,010 | 1,214 | 558 | 3.2 | 4,395.2 | 4,395.2 | 4,395.2 | 0.0 |
| V | 21,450 | 1,523 | 893 | 2.0 | 4,398.3 | 4,398.3 | 4,398.3 | 0.0 |
| W | 22,290 | 1,545 | 570 | 2.7 | 4,403.2 | 4,403.2 | 4,403.2 | 0.0 |
| X | 23,450 | 1,995 | 972 | 1.6 | 4,409.0 | 4,409.0 | 4,409.0 | 0.0 |
| Y | 24,770 | 1,653 | 1,016 | 1.4 | 4,413.1 | 4,413.1 | 4,413.1 | 0.0 |
| Z | 24,930 | 1,432 | 1,929 | 0.7 | 4,416.5 | 4,416.5 | 4,416.5 | 0.0 |

¹ Feet above confluence with Camp Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
 AND INCORPORATED AREAS

FLOODWAY DATA

BAKER CREEK WEST OVERFLOW

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Baker Creek West Overflow (Continued) | | | | | | | | |
| AA | 25,370 | 800 | 553 | 2.5 | 4,418.9 | 4,418.9 | 4,418.9 | 0.0 |
| AB | 26,550 | 1,537 | 863 | 1.6 | 4,424.6 | 4,424.6 | 4,424.6 | 0.0 |
| AC | 27,630 | 1,660 | 1,364 | 1.0 | 4,429.7 | 4,429.7 | 4,429.7 | 0.0 |
| AD | 28,250 | 1,514 | 969 | 1.4 | 4,432.7 | 4,432.7 | 4,432.7 | 0.0 |
| AE | 29,570 | 1,392 | 1,201 | 1.2 | 4,438.7 | 4,438.7 | 4,438.7 | 0.0 |
| AF | 30,050 | 1,155 | 1,050 | 1.3 | 4,440.9 | 4,440.9 | 4,440.9 | 0.0 |
| AG | 31,270 | 470 | 494 | 1.7 | 4,448.7 | 4,448.7 | 4,448.7 | 0.0 |
| AH | 31,870 | 799 | 1,111 | 0.8 | 4,450.5 | 4,450.5 | 4,450.5 | 0.0 |
| AI | 32,200 | 610 | 664 | 2.9 | 4,455.0 | 4,455.0 | 4,455.0 | 0.0 |
| AJ | 32,880 | 1,767 | 1,176 | 1.6 | 4,459.0 | 4,459.0 | 4,459.0 | 0.0 |
| AK | 34,040 | 1,667 | 1,503 | 1.3 | 4,466.2 | 4,466.2 | 4,466.2 | 0.0 |
| AL | 34,500 | 1,001 | 1,225 | 1.6 | 4,468.0 | 4,468.0 | 4,468.0 | 0.0 |
| AM | 35,180 | 1,244 | 1,227 | 1.6 | 4,472.4 | 4,472.4 | 4,472.4 | 0.0 |
| AN | 35,860 | 1,390 | 1,518 | 1.3 | 4,475.7 | 4,475.7 | 4,475.7 | 0.0 |
| AO | 36,860 | 1,071 | 1,006 | 1.9 | 4,479.9 | 4,479.9 | 4,479.9 | 0.0 |
| AP | 38,140 | 590 | 835 | 1.9 | 4,484.1 | 4,484.1 | 4,484.1 | 0.0 |
| AQ | 40,540 | 1,191 | 1,041 | 1.4 | 4,496.0 | 4,496.0 | 4,496.0 | 0.0 |
| AR | 41,580 | 1,091 | 1,146 | 1.3 | 4,499.2 | 4,499.2 | 4,499.2 | 0.0 |
| AS | 42,340 | 1,100 | 1,073 | 1.4 | 4,502.3 | 4,502.3 | 4,502.3 | 0.0 |
| AT | 42,940 | 730 | 1,545 | 1.0 | 4,503.5 | 4,503.5 | 4,503.5 | 0.0 |
| AU | 43,216 | 1,560 | 2,529 | 0.6 | 4,506.7 | 4,506.7 | 4,506.7 | 0.0 |

¹ Feet above confluence with Camp Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

BAKER CREEK WEST OVERFLOW

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|--|-----------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 2,695 | 51 | 11 | 2.4 | 4,901.5 | 4,901.5 | 4,901.5 | 0.0 |
| B | 2,932 | 60 ² | 10.5 | 2.5 | 4,903.7 | 4,903.5 | 4,903.5 | 0.0 |
| ¹ Feet above confluence with Garfield Street Split | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | BLACK AVENUE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|--------------|----------------------------|---------------------------------|--|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 61 | 136 | 395 | 2.7 | 4,718.9 | 4,717.9 | 4,718.2 | 0.3 |
| B | 321 | 133 | 414 | 2.5 | 4,718.2 | 4,718.2 | 4,718.6 | 0.4 |
| C | 961 | 83 | 199 | 5.3 | 4,723.9 | 4,723.9 | 4,724.2 | 0.3 |
| D | 1,253 | 66 | 154 | 6.8 | 4,726.6 | 4,726.6 | 4,726.6 | 0.0 |
| E | 1,410 | 64 | 257 | 4.1 | 4,729.0 | 4,729.0 | 4,729.0 | 0.0 |
| F | 2,032 | 63 | 152 | 6.9 | 4,733.7 | 4,733.7 | 4,733.9 | 0.2 |
| G | 2,707 | 97 | 194 | 5.4 | 4,739.2 | 4,739.2 | 4,739.2 | 0.0 |
| H | 3,357 | 106 | 188 | 5.6 | 4,744.9 | 4,744.9 | 4,745.1 | 0.2 |
| I | 3,503 | 64 | 248 | 4.2 | 4,747.2 | 4,747.2 | 4,747.3 | 0.1 |
| J | 3,817 | 151 | 343 | 3.9 | 4,752.7 | 4,752.7 | 4,752.7 | 0.0 |
| K | 4,253 | 46 | 179 | 5.7 | 4,753.1 | 4,753.1 | 4,753.5 | 0.4 |
| L | 4,766 | 36 | 162 | 6.3 | 4,759.0 | 4,759.0 | 4,759.1 | 0.1 |
| M | 5,170 | 41 | 177 | 5.3 | 4,761.8 | 4,761.8 | 4,761.8 | 0.0 |
| N | 5,551 | 36 | 176 | 5.4 | 4,767.4 | 4,767.4 | 4,767.4 | 0.0 |
| O | 6,297 | 35 | 150 | 6.1 | 4,774.8 | 4,774.8 | 4,774.8 | 0.0 |
| P | 6,765 | 85 | 235 | 3.9 | 4,782.4 | 4,782.4 | 4,782.7 | 0.3 |
| Q | 7,189 | 33 | 92 | 9.4 | 4,784.3 | 4,784.3 | 4,784.3 | 0.0 |
| R | 7,530 | 73 | 177 | | 4,789.6 | 4,789.6 | 4,790.0 | 0.4 |
| S | 7,863 | 27 | 102 | 8.4 | 4,792.1 | 4,792.1 | 4,792.3 | 0.2 |
| T | 8,225 | 42 | 135 | 6.4 | 4,796.7 | 4,796.7 | 4,796.7 | 0.0 |
| U | 8,627 | 235 | 310 | 2.8 | 4,800.5 | 4,800.5 | 4,800.5 | 0.0 |

¹ Feet above confluence with East Gallatin River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

GALLATIN COUNTY, MT

AND INCORPORATED AREAS

FLOODWAY DATA

BOZEMAN CREEK

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| V | 9,009 | 100 | 216 | 3.9 | 4,805.0 | 4,805.0 | 4,805.3 | 0.3 |
| W | 9,573 | 209 | 430 | 2.4 | 4,814.0 | 4,814.0 | 4,814.0 | 0.0 |
| X | 9,905 | 212 | 533 | 1.6 | 4,817.5 | 4,817.5 | 4,817.5 | 0.0 |
| Y | 10,582 | 46 | 137 | 7.3 | 4,821.7 | 4,821.7 | 4,821.7 | 0.0 |
| Z | 10,970 | 34 | 128 | 7.9 | 4,826.8 | 4,826.8 | 4,826.8 | 0.0 |
| AA | 11,367 | 27 | 135 | 7.5 | 4,832.6 | 4,832.6 | 4,832.6 | 0.0 |
| AB | 11,781 | 50 | 214 | 4.7 | 4,837.3 | 4,837.3 | 4,837.3 | 0.0 |
| AC | 12,267 | 153 | 202 | 5.6 | 4,842.1 | 4,842.1 | 4,842.1 | 0.0 |
| AD | 12,350 | 80 | 257 | 4.4 | 4,843.2 | 4,843.2 | 4,843.2 | 0.0 |
| AE | 12,960 | 245 ² | 269 | 4.2 | 4,848.0 | 4,848.0 | 4,848.0 | 0.0 |
| AF | 13,506 | 350 ² | 398 | 2.8 | 4,851.0 | 4,851.0 | 4,851.3 | 0.3 |
| AG | 13,932 | 149 | 356 | 9.0 | 4,855.2 | 4,855.2 | 4,855.4 | 0.2 |
| AH | 14,471 | 41 | 137 | 5.0 | 4,858.3 | 4,858.3 | 4,858.8 | 0.5 |
| AI | 15,162 | 96 | 170 | 4.0 | 4,862.9 | 4,862.9 | 4,863.2 | 0.3 |
| AJ | 15,545 | 31 | 119 | 5.7 | 4,865.0 | 4,865.0 | 4,865.5 | 0.5 |
| AK | 15,842 | 34 | 109 | 6.2 | 4,868.0 | 4,868.0 | 4,868.3 | 0.3 |
| AL | 16,299 | 69 ² | 116 | 5.9 | 4,870.7 | 4,870.7 | 4,871.0 | 0.3 |
| AM | 16,704 | 48 | 172 | 4.0 | 4,875.6 | 4,875.6 | 4,875.7 | 0.1 |
| AN | 17,312 | 34 | 110 | 6.2 | 4,882.0 | 4,882.0 | 4,882.0 | 0.0 |
| AO | 17,686 | 52 | 156 | 4.4 | 4,885.8 | 4,885.8 | 4,885.8 | 0.0 |
| AP | 18,140 | 28 | 74 | 9.2 | 4,889.7 | 4,889.7 | 4,889.7 | 0.0 |

¹ Feet above confluence with East Gallatin River

| | | |
|---------|---|----------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | BOZEMAN CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| AQ | 18,559 | 99 | 219 | 3.1 | 4,893.7 | 4,893.7 | 4,894.0 | 0.3 |
| AR | 19,042 | 24 | 101 | 6.3 | 4,898.1 | 4,898.1 | 4,898.6 | 0.5 |
| AS | 19,387 | 81 | 182 | 3.5 | 4,900.8 | 4,900.8 | 4,900.8 | 0.0 |
| AT | 19,933 | 160 | 204 | 3.1 | 4,904.3 | 4,904.3 | 4,904.6 | 0.3 |
| AU | 20,476 | 28 | 92 | 6.9 | 4,909.0 | 4,909.0 | 4,909.0 | 0.0 |
| AV | 20,786 | 63 | 139 | 3.9 | 4,911.2 | 4,911.2 | 4,911.2 | 0.0 |
| AW | 21,307 | 30 | 86 | 6.2 | 4,914.2 | 4,914.2 | 4,914.5 | 0.3 |
| AX | 21,766 | 34 | 104 | 5.1 | 4,919.0 | 4,919.0 | 4,919.2 | 0.2 |
| AY | 22,348 | 64 | 109 | 4.9 | 4,923.5 | 4,923.5 | 4,923.9 | 0.4 |
| AZ | 22,755 | 78 | 150 | 3.6 | 4,928.8 | 4,928.8 | 4,928.8 | 0.0 |
| BA | 22,960 | 28 | 108 | 4.9 | 4,931.9 | 4,931.9 | 4,931.9 | 0.0 |
| BB | 23,292 | 32 | 96 | 5.5 | 4,935.0 | 4,935.0 | 4,935.0 | 0.0 |
| BC | 23,560 | 23 | 79 | 6.7 | 4,937.7 | 4,937.7 | 4,937.7 | 0.0 |
| BD | 23,953 | 38 | 103 | 5.2 | 4,941.7 | 4,941.7 | 4,941.8 | 0.1 |
| BE | 24,567 | 30 | 91 | 5.9 | 4,947.8 | 4,947.8 | 4,947.9 | 0.1 |
| BF | 24,977 | 159 | 159 | 3.4 | 4,952.3 | 4,952.3 | 4,952.6 | 0.3 |
| BG | 25,342 | 70 | 123 | 4.3 | 4,954.5 | 4,954.5 | 4,954.8 | 0.3 |
| BH | 25,699 | 107 | 210 | 2.5 | 4,957.1 | 4,957.1 | 4,957.6 | 0.5 |
| BI | 26,012 | 93 | 160 | 3.3 | 4,959.5 | 4,959.5 | 4,959.6 | 0.1 |
| BJ | 26,624 | 106 | 166 | 3.2 | 4,963.9 | 4,963.9 | 4,964.4 | 0.5 |
| BK | 27,296 | 48 | 118 | 4.5 | 4,972.0 | 4,972.0 | 4,972.0 | 0.0 |

¹ Feet above confluence with East Gallatin River

| | | |
|---------|---|----------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | BOZEMAN CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| BL | 27,684 | 108 | 214 | 4.1 | 4,974.0 | 4,974.0 | 4,974.1 | 0.1 |
| BM | 28,041 | 54 | 186 | 4.7 | 4,978.5 | 4,978.5 | 4,978.9 | 0.4 |
| BN | 28,687 | 45 | 147 | 6.0 | 4,983.8 | 4,983.8 | 4,983.9 | 0.1 |
| BO | 29,316 | 32 | 112 | 6.6 | 4,989.3 | 4,989.3 | 4,989.4 | 0.1 |
| BP | 29,721 | 30 | 98 | 7.6 | 4,993.3 | 4,993.3 | 4,993.3 | 0.0 |
| BQ | 30,507 | 29 | 82 | 9.1 | 5,001.0 | 5,001.0 | 5,001.0 | 0.0 |
| BR | 31,302 | 45 | 114 | 6.5 | 5,009.9 | 5,009.9 | 5,010.2 | 0.3 |
| BS | 31,772 | 36 | 115 | 6.4 | 5,016.9 | 5,016.9 | 5,016.9 | 0.0 |
| BT | 32,217 | 37 | 128 | 5.6 | 5,020.2 | 5,020.2 | 5,020.2 | 0.0 |
| BU | 32,491 | 77 | 170 | 4.6 | 5,022.7 | 5,022.7 | 5,022.7 | 0.0 |
| BV | 32,709 | 95 | 212 | 3.7 | 5,024.6 | 5,024.6 | 5,024.8 | 0.2 |
| BW | 33,782 | 97 | 191 | 4.1 | 5,032.1 | 5,032.1 | 5,032.3 | 0.2 |
| BX | 34,449 | 34 | 128 | 6.1 | 5,037.5 | 5,037.5 | 5,037.5 | 0.0 |
| BY | 35,745 | 70 | 154 | 5.1 | 5,047.7 | 5,047.7 | 5,048.2 | 0.5 |
| BZ | 36,929 | 102 ² | 194 | 4.0 | 5,057.6 | 5,057.6 | 5,058.0 | 0.4 |
| CA | 37,744 | 64 | 119 | 6.5 | 5,065.9 | 5,065.9 | 5,066.3 | 0.4 |
| CB | 38,737 | 36 | 125 | 6.2 | 5,077.0 | 5,077.0 | 5,077.0 | 0.0 |
| CC | 39,830 | 51 | 155 | 5.0 | 5,088.5 | 5,088.5 | 5,088.9 | 0.4 |
| CD | 40,502 | 78 | 171 | 4.5 | 5,095.3 | 5,095.3 | 5,095.8 | 0.5 |
| CE | 41,142 | 36 | 109 | 7.1 | 5,102.4 | 5,102.4 | 5,102.7 | 0.3 |
| CF | 41,643 | 44 | 96 | 8.1 | 5,109.0 | 5,109.0 | 5,109.1 | 0.1 |

¹ Feet above confluence with East Gallatin River

| | | |
|---------|---|----------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | BOZEMAN CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|-----------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| CG | 42,337 | 51 | 138 | 5.6 | 5,116.0 | 5,116.0 | 5,116.2 | 0.2 |
| CH | 43,067 | 48 | 134 | 5.8 | 5,124.5 | 5,124.5 | 5,124.5 | 0.0 |
| CI | 43,944 | 100 | 212 | 3.7 | 5,134.1 | 5,134.1 | 5,134.5 | 0.4 |
| CJ | 44,994 | 71 | 160 | 4.8 | 5,143.6 | 5,143.6 | 5,144.0 | 0.4 |
| CK | 45,788 | 41 | 83 | 6.7 | 5,154.1 | 5,154.1 | 5,154.5 | 0.4 |
| CL | 46,610 | 21 | 85 | 6.5 | 5,164.0 | 5,164.0 | 5,164.0 | 0.0 |
| CM | 47,519 | 81 ³ | 76 | 9.7 | 5,176.0 | 5,176.0 | 5,176.0 | 0.0 |
| CN | 47,979 | 96 ³ | 164 | 4.7 | 5,181.8 | 5,181.8 | 5,181.8 | 0.0 |
| ¹ Feet above confluence with East Gallatin River | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | BOZEMAN CREEK | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Bridger Creek | | | | | | | | |
| A | 360 | 130 | 259 | 4.5 | 4,690.7 | 4,690.7 | 4,691.2 | 0.5 |
| B | 1,410 | 275 | 334 | 3.4 | 4,697.3 | 4,697.3 | 4,697.8 | 0.5 |
| C | 2,370 | 52 | 148 | 7.8 | 4,705.5 | 4,705.5 | 4,705.8 | 0.3 |
| D | 2,970 | 46 | 169 | 6.8 | 4,712.0 | 4,712.0 | 4,712.3 | 0.4 |
| E | 3,410 | 60 | 200 | 5.7 | 4,716.3 | 4,716.3 | 4,716.4 | 0.1 |
| F | 4,440 | 41 | 147 | 7.8 | 4,724.5 | 4,724.5 | 4,724.5 | 0.0 |
| G | 5,150 | 46 | 179 | 6.4 | 4,731.8 | 4,731.8 | 4,731.8 | 0.0 |
| H | 5,262 | 126 | 433 | 2.5 | 4,732.1 | 4,732.1 | 4,732.6 | 0.5 |
| I | 7,310 | 42 | 206 | 5.2 | 4,750.9 | 4,750.9 | 4,751.4 | 0.5 |
| J | 9,800 | 25 | 148 | 7.2 | 4,777.2 | 4,777.2 | 4,777.7 | 0.5 |
| K | 12,100 | 60 | 251 | 4.0 | 4,795.9 | 4,795.9 | 4,796.4 | 0.5 ² |
| L | 12,250 | 87 | 315 | 3.5 | 4,797.8 | 4,797.8 | 4,798.3 | 0.5 ² |
| M | 12,430 | 92 | 369 | 3.5 | 4,801.4 | 4,801.4 | 4,801.9 | 0.5 ² |
| N | 13,440 | 41 | 214 | 6.1 | 4,810.3 | 4,810.3 | 4,810.8 | 0.5 |
| O | 14,480 | 398 | 894 | 1.5 | 4,813.3 | 4,813.3 | 4,813.8 | 0.5 |
| P | 15,568 | 94 | 359 | 3.6 | 4,820.5 | 4,820.5 | 4,821.0 | 0.5 |
| Q | 15,960 | 342 | 674 | 1.9 | 4,825.4 | 4,825.4 | 4,825.9 | 0.5 |
| R | 18,272 | 79 | 306 | 4.3 | 4,846.6 | 4,846.6 | 4,847.1 | 0.5 ² |
| S | 18,468 | 71 | 365 | 3.6 | 4,848.8 | 4,848.8 | 4,849.3 | 0.5 ² |
| T | 19,568 | 313 | 670 | 1.9 | 4,858.9 | 4,858.9 | 4,859.4 | 0.5 |
| U | 20,183 | 50 | 208 | 6.1 | 4,868.8 | 4,868.8 | 4,869.3 | 0.5 ² |
| V | 20,305 | 39 | 168 | 7.5 | 4,872.0 | 4,872.0 | 4,872.5 | 0.5 ² |
| W | 20,464 | 221 | 1,118 | 1.1 | 4,873.1 | 4,873.1 | 4,873.6 | 0.5 |
| X | 21,334 | 35 | 181 | 7.0 | 4,884.2 | 4,884.2 | 4,884.7 | 0.5 ² |

¹ Feet above confluence with East Gallatin River

² Floodway confined within channel banks. Floodway water surface elevation may be less than 0.5 foot higher than floodway condition.

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS**

FLOODWAY DATA

BRIDGER CREEK

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|-----------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Buster Gulch | | | | | | | | |
| A | 5,076 | 100 | 534 | 1.0 | 4,480.7 | 4,480.7 | 4,480.8 | 0.1 |
| B | 5,144 | 324 | 577 | 1.2 | 4,480.7 | 4,480.7 | 4,480.7 | 0.0 |
| C | 5,736 | 186 | 291 | 2.3 | 4,482.3 | 4,482.3 | 4,482.8 | 0.4 |
| D | 6,269 | 133 | 191 | 3.5 | 4,484.9 | 4,484.9 | 4,485.2 | 0.4 |
| E | 7,279 | 299 | 425 | 1.6 | 4,488.8 | 4,488.8 | 4,489.2 | 0.4 |
| F | 7,911 | 243 | 244 | 2.8 | 4,491.9 | 4,491.9 | 4,492.2 | 0.3 |
| G | 8,494 | 259 | 370 | 1.8 | 4,495.3 | 4,495.3 | 4,495.7 | 0.4 |
| H | 9,028 | 204 | 287 | 2.4 | 4,497.7 | 4,497.7 | 4,498.0 | 0.3 |
| I | 9,800 | 349 | 356 | 1.9 | 4,501.2 | 4,501.2 | 4,501.5 | 0.2 |
| J | 10,032 | 329 | 495 | 1.4 | 4,502.6 | 4,502.6 | 4,502.8 | 0.1 |
| K | 10,156 | 186 | 199 | 3.4 | 4,504.5 | 4,504.5 | 4,504.6 | 0.1 |
| L | 10,639 | 166 | 259 | 2.6 | 4,507.2 | 4,507.2 | 4,507.4 | 0.2 |
| M | 11,139 | 195 | 290 | 2.3 | 4,508.8 | 4,508.8 | 4,509.1 | 0.3 |
| N | 11,561 | 117 | 142 | 4.7 | 4,513.0 | 4,513.0 | 4,513.0 | 0.1 |
| O | 11,721 | 220 | 712 | 1.0 | 4,517.1 | 4,517.1 | 4,517.3 | 0.2 |
| P | 12,777 | 255 | 306 | 2.2 | 4,520.1 | 4,520.1 | 4,520.5 | 0.3 |
| Q | 13,286 | 235 | 264 | 2.6 | 4,523.6 | 4,523.6 | 4,523.6 | 0.1 |
| R | 14,079 | 141 | 223 | 3.0 | 4,527.5 | 4,527.5 | 4,527.6 | 0.1 |
| S | 14,703 | 143 | 214 | 3.2 | 4,530.8 | 4,530.8 | 4,531.2 | 0.5 |
| T | 15,313 | 71 | 174 | 3.9 | 4,534.4 | 4,534.4 | 4,534.7 | 0.3 |
| U | 16,534 | 102 | 207 | 3.3 | 4,539.3 | 4,539.3 | 4,539.7 | 0.4 |
| V | 17,136 | 178 | 228 | 3.0 | 4,541.6 | 4,541.6 | 4,542.1 | 0.5 |
| W | 17,735 | 129 | 255 | 2.9 | 4,545.1 | 4,545.1 | 4,545.3 | 0.2 |
| X | 17,907 | 150 | 423 | 1.6 | 4,548.2 | 4,548.2 | 4,548.6 | 0.4 |
| Y | 18,739 | 67 | 161 | 4.2 | 4,549.5 | 4,549.5 | 4,549.9 | 0.4 |
| Z | 19,411 | 189 | 239 | 2.8 | 4,553.0 | 4,553.0 | 4,553.5 | 0.5 |

¹ Stream distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

BUSTER GULCH

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|--------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Buster Gulch (continued) | | | | | | | | |
| AA | 19,860 | 105 | 427 | 1.6 | 4,555.7 | 4,555.7 | 4,556.0 | 0.3 |
| AB | 21,085 | 248 | 781 | 7.4 | 4,557.6 | 4,557.6 | 4,557.7 | 0.1 |
| AC | 21,788 | 211 | 435 | 2.3 | 4,562.4 | 4,562.4 | 4,562.8 | 0.4 |

¹ Stream distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
 AND INCORPORATED AREAS

FLOODWAY DATA

BUSTER GULCH

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|-----------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Camp Creek | | | | | | | | |
| A | 250 | 2,056 | 11,239 | 0.1 | 4,266.9 | 4,266.9 | 4,266.9 | 0.0 |
| B | 1,050 | 1,770 | 6,961 | 0.3 | 4,267.8 | 4,267.8 | 4,267.8 | 0.0 |
| C | 2,540 | 1,509 | 1,214 | 1.0 | 4,268.4 | 4,268.4 | 4,268.4 | 0.0 |
| D | 3,560 | 1,106 | 1,102 | 1.1 | 4,271.9 | 4,271.9 | 4,271.9 | 0.0 |
| E | 5,480 | 1,230 | 568 | 1.0 | 4,278.3 | 4,278.3 | 4,278.3 | 0.0 |
| F | 6,870 | 850 | 396 | 1.4 | 4,282.2 | 4,282.2 | 4,282.2 | 0.0 |
| G | 7,470 | 850 | 497 | 1.1 | 4,284.4 | 4,284.4 | 4,284.4 | 0.0 |
| H | 8,510 | 730 | 416 | 1.3 | 4,287.1 | 4,287.1 | 4,287.1 | 0.0 |
| I | 10,050 | 1,350 | 609 | 0.9 | 4,290.0 | 4,290.0 | 4,290.0 | 0.0 |
| J | 10,960 | 188 | 336 | 2.9 | 4,297.7 | 4,297.7 | 4,297.7 | 0.0 |
| K | 12,850 | 270 | 334 | 3.0 | 4,304.5 | 4,304.5 | 4,304.5 | 0.0 |

¹ Feet above confluence with Baker Creek Area

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
 AND INCORPORATED AREAS

FLOODWAY DATA

CAMP CREEK

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|---|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 590 | 97 | 91 | 1.0 | 4,756.5 | 4,756.5 | 4,756.5 | 0.0 |
| B | 932 | 32 | 49 | 1.8 | 4,756.6 | 4,756.6 | 4,756.7 | 0.1 |
| C | 1,312 | 61 | 27 | 3.3 | 4,757.0 | 4,757.0 | 4,757.0 | 0.0 |
| ¹ Feet above confluence with Mill Ditch Diversion | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | CEDAR STREET SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|--|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 2,919 | 63 | 58 | 2.9 | 4,815.4 | 4,815.4 | 4,815.4 | 0.0 |
| B | 3,449 | 66 | 39 | 4.3 | 4,817.8 | 4,817.8 | 4,817.8 | 0.0 |
| C | 3,601 | 56 | 86 | 2.8 | 4,818.8 | 4,818.8 | 4,818.8 | 0.0 |
| ¹ Feet above confluence with Bozeman Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | CHURCH AVENUE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River | | | | | | | | |
| A | 534 | 191 | 838 | 3.3 | 4,465.9 | 4,465.9 | 4,466.2 | 0.3 |
| B | 1,233 | 135 | 460 | 6.4 | 4,468.5 | 4,468.5 | 4,468.6 | 0.1 |
| C | 1,767 | 212 | 718 | 3.8 | 4,471.6 | 4,471.6 | 4,471.7 | 0.1 |
| D | 2,274 | 262 | 637 | 4.3 | 4,473.8 | 4,473.8 | 4,474.0 | 0.2 |
| E | 2,997 | 385 | 878 | 3.1 | 4,477.5 | 4,477.5 | 4,478.0 | 0.5 |
| F | 3,798 | 245 | 636 | 4.3 | 4,482.1 | 4,482.1 | 4,482.4 | 0.3 |
| G | 4,256 | 179 | 525 | 5.1 | 4,485.0 | 4,485.0 | 4,485.0 | 0.0 |
| H | 5,017 | 110 | 412 | 6.7 | 4,489.3 | 4,489.3 | 4,489.7 | 0.4 |
| I | 5,566 | 226 | 652 | 4.2 | 4,492.8 | 4,492.8 | 4,493.2 | 0.4 |
| J | 6,091 | 365 | 885 | 3.1 | 4,495.3 | 4,495.3 | 4,495.5 | 0.2 |
| K | 6,585 | 321 | 784 | 3.5 | 4,497.7 | 4,497.7 | 4,497.7 | 0.1 |
| L | 7,214 | 208 | 444 | 6.2 | 4,501.4 | 4,501.4 | 4,501.4 | 0.0 |
| M | 7,841 | 291 | 660 | 4.2 | 4,505.6 | 4,505.6 | 4,505.7 | 0.1 |
| N | 8,770 | 461 | 1,020 | 2.7 | 4,509.6 | 4,509.6 | 4,510.1 | 0.5 |
| O | 9,633 | 377 | 877 | 3.1 | 4,512.8 | 4,512.8 | 4,513.2 | 0.4 |
| P | 10,146 | 324 | 473 | 5.8 | 4,516.3 | 4,516.3 | 4,516.5 | 0.2 |
| Q | 10,687 | 203 | 607 | 4.5 | 4,520.1 | 4,520.1 | 4,520.2 | 0.1 |
| R | 11,213 | 122 | 481 | 5.7 | 4,523.0 | 4,523.0 | 4,523.1 | 0.1 |
| S | 12,586 | 287 | 774 | 3.6 | 4,529.5 | 4,529.5 | 4,530.0 | 0.5 |
| T | 13,655 | 410 | 855 | 3.2 | 4,534.3 | 4,534.3 | 4,534.8 | 0.5 |
| U | 15,101 | 635 | 1,264 | 2.2 | 4,537.9 | 4,537.9 | 4,538.4 | 0.5 |
| V | 15,983 | 268 | 447 | 6.2 | 4,541.3 | 4,541.3 | 4,541.4 | 0.1 |
| W | 16,766 | 485 | 1,184 | 2.3 | 4,545.7 | 4,545.7 | 4,546.2 | 0.5 |
| X | 17,788 | 194 | 545 | 5.0 | 4,549.8 | 4,549.8 | 4,550.2 | 0.3 |
| Y | 18,603 | 547 | 1,198 | 2.3 | 4,553.1 | 4,553.1 | 4,553.5 | 0.4 |
| Z | 19,967 | 716 | 1,439 | 1.9 | 4,556.2 | 4,556.2 | 4,556.3 | 0.1 |

¹ Distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---------------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River (continued) | | | | | | | | |
| AA | 20,576 | 158 | 419 | 6.6 | 4,558.5 | 4,558.5 | 4,558.6 | 0.1 |
| AB | 21,081 | 186 | 853 | 3.2 | 4,562.8 | 4,562.8 | 4,562.9 | 0.1 |
| AC | 22,433 | 402 | 685 | 4.0 | 4,566.5 | 4,566.5 | 4,566.9 | 0.4 |
| AD | 23,450 | 931 | 1,511 | 1.8 | 4,569.6 | 4,569.6 | 4,570.0 | 0.4 |
| AE | 25,206 | 565 | 696 | 1.8 | 4,572.6 | 4,572.6 | 4,573.0 | 0.4 |
| AF | 25,733 | 472 | 1,006 | 1.3 | 4,574.0 | 4,574.0 | 4,574.0 | 0.0 |
| AG | 26,573 | 274 | 312 | 4.0 | 4,576.7 | 4,576.7 | 4,576.7 | 0.0 |
| AH | 28,420 | 385 | 538 | 2.3 | 4,585.9 | 4,585.9 | 4,586.2 | 0.3 |
| AI | 30,876 | 922 | 2,230 | 0.6 | 4,585.9 | 4,585.9 | 4,586.2 | 0.3 |
| AJ | 31,458 | 496 | 399 | 3.2 | 4,589.1 | 4,589.1 | 4,589.5 | 0.4 |
| AK | 31,876 | 1,363 | 1,616 | 2.1 | 4,594.1 | 4,594.1 | 4,594.3 | 0.3 |
| AL | 33,723 | 576 | 1,250 | 2.0 | 4,599.0 | 4,599.0 | 4,599.5 | 0.5 |
| AM | 35,148 | 139 | 448 | 5.6 | 4,602.8 | 4,602.8 | 4,602.9 | 0.1 |
| AN | 37,938 | 551 | 847 | 2.9 | 4,611.5 | 4,611.5 | 4,611.9 | 0.4 |
| AO | 40,903 | 190 | 510 | 4.9 | 4,618.8 | 4,618.8 | 4,619.1 | 0.3 |
| AP | 40,952 | 89 | 359 | 6.9 | 4,618.8 | 4,618.8 | 4,619.3 | 0.5 |
| AQ | 41,102 | 89 | 496 | 5.0 | 4,621.5 | 4,621.5 | 4,621.5 | 0.0 |
| AR | 41,316 | 277 | 1,353 | 1.8 | 4,622.2 | 4,622.2 | 4,622.2 | 0.0 |
| AS | 41,739 | 382 | 643 | 4.4 | 4,622.6 | 4,622.6 | 4,622.7 | 0.1 |
| AT | 42,478 | 458 | 980 | 2.6 | 4,623.2 | 4,623.2 | 4,623.6 | 0.4 |
| AU | 43,177 | 130 | 374 | 6.7 | 4,627.4 | 4,627.4 | 4,627.6 | 0.2 |
| AV | 44,473 | 473 | 742 | 3.4 | 4,633.7 | 4,633.7 | 4,634.2 | 0.5 |
| AW | 45,420 | 60 | 374 | 6.7 | 4,636.9 | 4,636.9 | 4,637.1 | 0.2 |
| AX | 47,551 | 717 | 658 | 3.8 | 4,647.8 | 4,647.8 | 4,648.3 | 0.5 |
| AY | 49,074 | 278 | 512 | 4.9 | 4,654.4 | 4,654.4 | 4,654.9 | 0.5 |
| AZ | 52,461 | 460 | 1,176 | 3.1 | 4,662.8 | 4,662.8 | 4,663.2 | 0.4 |

¹ Distance in feet above Airport Road

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS**

FLOODWAY DATA

EAST GALLATIN RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---------------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River (continued) | | | | | | | | |
| BA | 53,307 | 119 | 324 | 7.7 | 4,665.7 | 4,665.7 | 4,665.8 | 0.1 |
| BB | 53,878 | 661 | 1,544 | 1.6 | 4,667.8 | 4,667.8 | 4,668.3 | 0.5 |
| BC | 54,923 | 91 | 311 | 8.0 | 4,670.1 | 4,670.1 | 4,670.2 | 0.1 |
| BD | 55,015 | 64 | 289 | 8.6 | 4,670.9 | 4,670.9 | 4,671.1 | 0.2 |
| BE | 55,064 | 64 | 352 | 7.1 | 4,671.9 | 4,671.9 | 4,671.9 | 0.0 |
| BF | 55,154 | 92 | 596 | 4.2 | 4,672.8 | 4,672.8 | 4,672.8 | 0.0 |
| BG | 55,507 | 90 | 411 | 6.1 | 4,673.5 | 4,673.5 | 4,673.5 | 0.0 |
| BH | 56,543 | 62 | 379 | 3.0 | 4,676.3 | 4,676.3 | 4,676.4 | 0.1 |
| BI | 57,105 | 89 | 326 | 4.9 | 4,677.1 | 4,677.1 | 4,677.2 | 0.1 |
| BJ | 57,832 | 114 | 469 | 3.4 | 4,678.8 | 4,678.8 | 4,679.0 | 0.2 |
| BK | 58,715 | 118 | 315 | 6.4 | 4,680.9 | 4,680.9 | 4,681.4 | 0.5 |
| BL | 59,282 | 355 | 919 | 2.8 | 4,683.0 | 4,683.0 | 4,683.5 | 0.5 |
| BM | 61,028 | 487 | 827 | 3.6 | 4,686.7 | 4,686.7 | 4,687.1 | 0.4 |
| BN | 61,564 | 644 | 985 | 2.3 | 4,688.3 | 4,688.3 | 4,688.8 | 0.5 |
| BO | 62,535 | 261 | 468 | 4.8 | 4,690.3 | 4,690.3 | 4,690.8 | 0.5 |
| BP | 63,644 | 121 | 326 | 6.9 | 4,696.8 | 4,696.8 | 4,697.3 | 0.5 |
| BQ | 64,861 | 690 | 1,059 | 2.1 | 4,701.5 | 4,701.5 | 4,701.9 | 0.4 |
| BR | 65,665 | 269 | 386 | 5.8 | 4,704.7 | 4,704.7 | 4,704.8 | 0.1 |
| BS | 66,031 | 227 | 806 | 2.8 | 4,706.1 | 4,706.1 | 4,706.5 | 0.4 |
| BT | 66,500 | 457 | 441 | 5.1 | 4,709.7 | 4,709.7 | 4,710.1 | 0.4 |
| BU | 66,721 | 428 | 410 | 5.5 | 4,710.9 | 4,710.9 | 4,711.4 | 0.5 |
| BV | 66,814 | 53 | 1,631 | 11.0 | 4,712.1 | 4,712.1 | 4,712.1 | 0.0 |
| BW | 66,924 | 1,028 | 3,170 | 0.7 | 4,714.8 | 4,714.8 | 4,715.1 | 0.3 |
| BX | 67,033 | 512 | 1,203 | 1.9 | 4,714.8 | 4,714.8 | 4,715.1 | 0.3 |
| BY | 67,633 | 90 | 241 | 9.3 | 4,715.5 | 4,715.5 | 4,715.5 | 0.0 |
| BZ | 68,350 | 75 | 374 | 4.7 | 4,721.0 | 4,721.0 | 4,721.2 | 0.2 |

¹ Distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---------------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River (continued) | | | | | | | | |
| CA | 68,557 | 323 | 925 | 1.9 | 4,721.6 | 4,721.6 | 4,721.9 | 0.3 |
| CB | 68,618 | 376 | 1,673 | 1.1 | 4,722.8 | 4,722.8 | 4,723.0 | 0.2 |
| CC | 68,661 | 396 | 1,377 | 1.3 | 4,723.1 | 4,723.1 | 4,723.3 | 0.2 |
| CD | 68,933 | 76 | 173 | 10.2 | 4,723.1 | 4,723.1 | 4,723.3 | 0.2 |
| CE | 69,729 | 372 | 897 | 2.0 | 4,726.8 | 4,726.8 | 4,726.8 | 0.0 |
| CF | 69,810 | 184 | 452 | 3.9 | 4,727.4 | 4,727.4 | 4,727.5 | 0.1 |
| CG | 70,322 | 49 | 198 | 9.0 | 4,729.5 | 4,729.5 | 4,729.6 | 0.1 |
| CH | 70,480 | 44 | 187 | 9.5 | 4,731.5 | 4,731.5 | 4,731.6 | 0.1 |
| CI | 70,735 | 71 | 274 | 7.5 | 4,735.0 | 4,735.0 | 4,735.1 | 0.1 |
| CJ | 70,850 | 531 | 1,832 | 1.3 | 4,737.4 | 4,737.4 | 4,737.4 | 0.0 |
| CK | 70,928 | 391 | 630 | 3.1 | 4,737.2 | 4,737.2 | 4,737.3 | 0.1 |
| CL | 71,699 | 154 | 484 | 3.7 | 4,739.4 | 4,739.4 | 4,739.6 | 0.2 |
| CM | 72,743 | 78 | 225 | 7.9 | 4,743.6 | 4,743.6 | 4,744.1 | 0.5 |
| CN | 73,730 | 42 | 226 | 7.4 | 4,753.5 | 4,753.5 | 4,753.6 | 0.1 |
| CO | 74,745 | 94 | 188 | 8.9 | 4,762.9 | 4,762.9 | 4,762.9 | 0.0 |
| CP | 74,831 | 162 | 285 | 5.9 | 4,764.8 | 4,764.8 | 4,764.8 | 0.0 |
| CQ | 74,886 | 265 | 409 | 4.1 | 4,765.5 | 4,765.5 | 4,765.8 | 0.3 |
| CR | 75,040 | 45 | 243 | 6.9 | 4,765.9 | 4,765.9 | 4,766.3 | 0.4 |
| CS | 75,256 | 51 | 243 | 6.9 | 4,767.0 | 4,767.0 | 4,767.5 | 0.5 |
| CT | 75,769 | 111 | 321 | 5.2 | 4,770.2 | 4,770.2 | 4,770.6 | 0.4 |
| CU | 76,240 | 38 | 148 | 11.3 | 4,775.3 | 4,775.3 | 4,775.3 | 0.0 |
| CV | 76,319 | 41 | 230 | 7.3 | 4,777.3 | 4,777.3 | 4,777.3 | 0.0 |
| CW | 76,405 | 52 | 303 | 5.5 | 4,778.0 | 4,778.0 | 4,778.1 | 0.1 |
| CX | 76,605 | 43 | 221 | 7.6 | 4,778.6 | 4,778.6 | 4,778.7 | 0.1 |
| CY | 76,907 | 70 | 275 | 6.1 | 4,780.7 | 4,780.7 | 4,780.9 | 0.2 |
| CZ | 78,147 | 161 | 406 | 4.1 | 4,787.0 | 4,787.0 | 4,787.5 | 0.5 |

¹ Distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---------------------------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River (continued) | | | | | | | | |
| DA | 72,969 | 55 | 276 | 6.0 | 4,797.1 | 4,797.1 | 4,797.6 | 0.5 |
| DB | 79,727 | 59 | 326 | 5.1 | 4,798.6 | 4,798.6 | 4,799.1 | 0.5 |
| DC | 80,982 | 64 | 261 | 5.7 | 4,806.5 | 4,806.5 | 4,807.0 | 0.5 |
| DD | 81,090 | 216 | 632 | 2.6 | 4,808.0 | 4,808.0 | 4,808.5 | 0.5 |
| DE | 82,166 | 195 | 482 | 3.3 | 4,813.5 | 4,813.5 | 4,814.0 | 0.5 |
| DF | 82,955 | 96 | 289 | 5.5 | 4,820.0 | 4,820.0 | 4,820.5 | 0.5 |
| DG | 85,542 | 196 | 529 | 3.1 | 4,836.9 | 4,836.9 | 4,837.4 | 0.5 |
| DH | 89,928 | 121 | 452 | 3.3 | 4,853.6 | 4,853.6 | 4,854.1 | 0.5 |
| DI | 90,020 | 255 | 1,096 | 1.4 | 4,854.7 | 4,854.7 | 4,855.2 | 0.5 |
| DJ | 92,915 | 197 | 422 | 3.6 | 4,869.3 | 4,869.3 | 4,869.8 | 0.5 |
| DK | 93,036 | 400 | 1,342 | 1.1 | 4,871.9 | 4,871.9 | 4,872.4 | 0.5 |
| DL | 95,720 | 235 | 562 | 2.7 | 4,880.4 | 4,880.4 | 4,880.9 | 0.5 |
| DM | 95,814 | 234 | 853 | 1.8 | 4,882.4 | 4,882.4 | 4,882.9 | 0.5 |
| DN | 99,680 | 150 | 492 | 3.1 | 4,906.6 | 4,906.6 | 4,907.1 | 0.5 |
| DO | 101,665 | 103 | 342 | 4.2 | 4,921.5 | 4,921.5 | 4,922.0 | 0.5 |
| DP | 101,770 | 70 | 244 | 5.9 | 4,922.6 | 4,922.6 | 4,923.1 | 0.5 |

¹ Distance in feet above Airport Road

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
 AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River Golf Course Reach | | | | | | | | |
| A | 87 | 72 | 184 | 5.8 | 4,604.5 | 4,604.5 | 4,605.0 | 0.5 |
| B | 333 | 73 | 138 | 7.7 | 4,606.9 | 4,606.9 | 4,607.0 | 0.2 |
| C | 980 | 424 | 394 | 2.7 | 4,609.1 | 4,609.1 | 4,609.5 | 0.5 |
| D | 1,345 | 558 | 311 | 3.4 | 4,611.4 | 4,611.4 | 4,611.4 | 0.1 |
| E | 1,966 | 154 | 219 | 4.9 | 4,613.9 | 4,613.9 | 4,614.3 | 0.4 |
| F | 2,369 | 392 | 370 | 2.9 | 4,616.7 | 4,616.7 | 4,616.8 | 0.1 |

¹ Feet above confluence with East Gallatin River Springhill Reach

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER GOLF COURSE REACH

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|--|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River Overflow Reach | | | | | | | | |
| A | 300 | 220 | 559 | 3.6 | 4,589.4 | 4,589.4 | 4,589.9 | 0.5 |
| B | 928 | 114 | 263 | 4.0 | 4,591.6 | 4,591.6 | 4,592.1 | 0.5 |
| C | 1,263 | 32 | 121 | 8.6 | 4,594.6 | 4,594.6 | 4,594.6 | 0.0 |
| D | 1,336 | 32 | 190 | 5.3 | 4,595.9 | 4,595.9 | 4,596.1 | 0.2 |
| E | 1,925 | 115 | 501 | 1.9 | 4,596.2 | 4,596.2 | 4,596.7 | 0.5 |
| F | 2,760 | 111 | 360 | 6.2 | 4,596.8 | 4,596.8 | 4,597.1 | 0.3 |
| G | 3,358 | 201 | 326 | 2.3 | 4,600.1 | 4,600.1 | 4,600.6 | 0.5 |
| H | 4,682 | 155 | 184 | 4.1 | 4,605.2 | 4,605.2 | 4,605.3 | 0.1 |
| I | 5,326 | 333 | 323 | 2.3 | 4,608.0 | 4,608.0 | 4,608.4 | 0.4 |
| J | 6,386 | 139 | 160 | 3.8 | 4,612.1 | 4,612.1 | 4,612.6 | 0.5 |
| K | 6,927 | 176 | 240 | 2.8 | 4,615.2 | 4,615.2 | 4,615.5 | 0.3 |
| L | 7,511 | 149 | 126 | 4.8 | 4,619.0 | 4,619.0 | 4,619.1 | 0.1 |
| M | 8,139 | 302 | 639 | 1.4 | 4,623.1 | 4,623.1 | 4,623.6 | 0.5 |
| N | 9,120 | 86 | 116 | 5.2 | 4,629.2 | 4,629.2 | 4,629.7 | 0.5 |
| O | 9,842 | 242 | 303 | 2.0 | 4,634.5 | 4,634.5 | 4,634.9 | 0.4 |
| P | 10,413 | 290 | 318 | 4.1 | 4,640.4 | 4,640.4 | 4,640.5 | 0.1 |
| Q | 10,983 | 206 | 196 | 2.8 | 4,645.4 | 4,645.4 | 4,645.8 | 0.4 |
| R | 11,424 | 211 | 146 | 3.8 | 4,648.5 | 4,648.5 | 4,649.0 | 0.5 |
| S | 11,994 | 81 | 130 | 4.2 | 4,653.4 | 4,653.4 | 4,653.9 | 0.5 |
| T | 12,077 | 290 | 139 | 3.9 | 4,656.0 | 4,656.0 | 4,656.0 | 0.0 |
| U | 12,642 | 216 | 194 | 2.2 | 4,659.6 | 4,659.6 | 4,660.0 | 0.4 |
| V | 13,227 | 93 | 86 | 4.9 | 4,662.0 | 4,662.0 | 4,662.2 | 0.2 |
| W | 13,452 | 270 | 414 | 1.0 | 4,662.5 | 4,662.5 | 4,662.9 | 0.4 |
| X | 13,846 | 69 | 72 | 5.9 | 4,664.5 | 4,664.5 | 4,664.6 | 0.1 |
| Y | 14,576 | 209 | 170 | 2.5 | 4,671.2 | 4,671.2 | 4,671.4 | 0.2 |
| Z | 14,776 | 48 | 65 | 6.6 | 4,673.5 | 4,673.5 | 4,673.5 | 0.0 |

¹ Feet above confluence with East Gallatin River

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS**

FLOODWAY DATA

EAST GALLATIN RIVER OVERFLOW REACH

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|--|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River Spillway Reach | | | | | | | | |
| A | 250 | 51 | 169 | 5.8 | 4,591.8 | 4,591.8 | 4,592.3 | 0.5 |
| B | 860 | 203 | 442 | 0.8 | 4,592.9 | 4,592.9 | 4,593.4 | 0.5 |
| C | 1,418 | 78 | 65 | 5.4 | 4,595.7 | 4,595.7 | 4,595.8 | 0.0 |
| D | 1,837 | 172 | 79 | 4.4 | 4,600.2 | 4,600.2 | 4,600.6 | 0.4 |
| E | 2,027 | 114 | 168 | 2.1 | 4,601.3 | 4,601.3 | 4,601.7 | 0.5 |
| F | 2,447 | 40 | 53 | 6.6 | 4,603.1 | 4,603.1 | 4,603.4 | 0.3 |

¹ Feet above confluence with East Gallatin River Overflow Reach

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER SPILLWAY REACH

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|---|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| East Gallatin River Springhill Reach | | | | | | | | |
| A | 240 | 98 | 88 | 1.0 | 4,596.0 | 4,596.0 | 4,596.5 | 0.5 |
| B | 660 | 46 | 52 | 4.3 | 4,597.2 | 4,597.2 | 4,597.5 | 0.3 |
| C | 995 | 105 | 181 | 3.9 | 4,598.9 | 4,598.9 | 4,599.2 | 0.3 |
| D | 1,435 | 73 | 152 | 4.7 | 4,600.6 | 4,600.6 | 4,601.1 | 0.5 |
| E | 1,635 | 68 | 129 | 5.5 | 4,601.8 | 4,601.8 | 4,602.2 | 0.4 |
| F | 1,950 | 88 | 192 | 3.7 | 4,603.5 | 4,603.5 | 4,603.6 | 0.2 |

¹ Feet above confluence with East Gallatin River Overflow Reach

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
 AND INCORPORATED AREAS

FLOODWAY DATA

EAST GALLATIN RIVER SPRINGHILL REACH

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 15 | 14 | 20 | 4.6 | 4,896.4 | 4,895.0 ² | 4,895.0 ² | 0.0 |
| B | 280 | 36 | 53 | 1.8 | 4,898.0 | 4,898.0 | 4,898.0 | 0.0 |
| C | 596 | 27 | 45 | 3.0 | 4,900.8 | 4,900.8 | 4,900.8 | 0.0 |
| D | 886 | 110 | 148 | 0.7 | 4,904.2 | 4,904.2 | 4,904.2 | 0.0 |
| E | 1,431 | 12 | 19 | 5.2 | 4,905.3 | 4,905.3 | 4,905.3 | 0.0 |
| F | 1,962 | 128 | 489 | 0.5 | 4,914.4 | 4,914.4 | 4,914.4 | 0.0 |
| G | 2,689 | 65 | 47 | 3.8 | 4,920.9 | 4,920.9 | 4,921.1 | 0.2 |
| H | 2,817 | 25 | 32 | 5.6 | 4,922.2 | 4,922.2 | 4,922.5 | 0.3 |
| I | 3,047 | 31 | 59 | 1.7 | 4,926.5 | 4,926.5 | 4,926.5 | 0.0 |
| J | 3,367 | 51 | 39 | 2.7 | 4,929.8 | 4,929.8 | 4,929.8 | 0.0 |
| K | 3,576 | 20 | 61 | 1.1 | 4,934.9 | 4,934.9 | 4,935.3 | 0.4 |
| L | 3,970 | 30 | 31 | 2.1 | 4,937.2 | 4,937.2 | 4,937.2 | 0.0 |
| M | 5,005 | 26 | 30 | 3.8 | 4,952.2 | 4,952.2 | 4,952.3 | 0.1 |
| N | 5,864 | 54 | 37 | 3.1 | 4,965.5 | 4,965.5 | 4,965.8 | 0.3 |
| O | 6,643 | 25 | 31 | 2.3 | 4,976.6 | 4,976.6 | 4,976.6 | 0.0 |
| P | 7,484 | 24 | 43 | 1.1 | 4,990.6 | 4,990.6 | 4,990.6 | 0.0 |
| Q | 7,727 | 20 | 12 | 4.1 | 4,994.6 | 4,994.6 | 4,994.6 | 0.0 |
| R | 8,618 | 8 | 13 | 2.6 | 5,008.6 | 5,008.6 | 5,008.6 | 0.0 |
| S | 9,071 | 11 | 15 | 2.3 | 5,014.3 | 5,014.3 | 5,014.3 | 0.0 |

¹Feet above confluence with Mathew Bird Creek

²Elevation shown without consideration of Mathew Bird Creek

| | | |
|---------|---|----------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | FIGGINS CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 1,191 | 10 | 10 | 4.2 | 4,902.7 | 4,902.7 | 4,902.7 | 0.0 |
| B | 1,299 | 125 ² | 45 | 3.1 | 4,905.1 | 4,905.1 | 4,905.1 | 0.0 |
| C | 1,890 | 13 | 35 | 0.7 | 4,912.2 | 4,912.2 | 4,912.2 | 0.0 |
| D | 2,076 | 5 | 5 | 5.4 | 4,912.3 | 4,912.3 | 4,912.3 | 0.0 |
| E | 2,464 | 7 | 7 | 3.7 | 4,915.6 | 4,915.6 | 4,915.6 | 0.0 |
| F | 2,832 | 8 | 10 | 2.5 | 4,918.4 | 4,918.4 | 4,918.4 | 0.0 |
| G | 3,268 | 8 | 13 | 2.0 | 4,923.2 | 4,923.2 | 4,923.3 | 0.1 |
| H | 3,948 | 11 | 21 | 2.5 | 4,930.9 | 4,930.9 | 4,931.1 | 0.2 |
| I | 4,282 | 11 | 24 | 1.1 | 4,935.2 | 4,935.2 | 4,935.3 | 0.1 |
| J | 4,830 | 13 | 21 | 1.2 | 4,940.1 | 4,940.1 | 4,940.3 | 0.2 |
| K | 5,031 | 9 | 22 | 1.2 | 4,942.0 | 4,942.0 | 4,942.3 | 0.3 |
| L | 5,384 | 37 | 35 | 0.7 | 4,946.7 | 4,946.7 | 4,946.7 | 0.0 |
| M | 5,566 | 40 | 21 | 1.3 | 4,947.9 | 4,947.9 | 4,948.1 | 0.2 |

¹Feet above Rouse Avenue Split

²Floodway topwidth includes width of high ground area

| | | |
|---------|---|---------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | FLOODWAY DATA |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLAT CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|---|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 318 | 133 ² | 62 | 3.6 | 4,906.8 | 4,906.8 | 4,906.8 | 0.0 |
| B | 697 | 54 ² | 44 | 5.1 | 4,909.2 | 4,909.2 | 4,909.2 | 0.0 |
| ¹ Feet above confluence with Mathew Bird Creek ² Floodway topwidth influenced by flow from Flat Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | FLAT/KAGY SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|--|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 45 | 55 | 22 | 3.6 | 4,839.5 | 4,839.5 | 4,839.5 | 0.0 |
| B | 279 | 112 | 98 | 0.8 | 4,840.5 | 4,840.5 | 4,840.5 | 0.0 |
| ¹ Feet above confluence with Mill Ditch Diversion | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | GALLAGATOR SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|--|--------------|------------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 1,117 | 106 | 62 | 3.5 | 4,867.1 | 4,867.1 | 4,867.1 | 0.0 |
| B | 1,459 | 126 | 90 | 3.1 | 4,868.9 | 4,868.9 | 4,868.9 | 0.0 |
| ¹ Feet above confluence with Rouse Avenue Split | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | GARFIELD STREET SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|---|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 356 | 165 | 146 | 2.3 | 4,911.8 | 4,911.8 | 4,911.8 | 0.0 |
| B | 755 | 323 ² | 228 | 1.7 | 4,912.9 | 4,912.9 | 4,912.9 | 0.0 |
| C | 1,266 | 275 ² | 62 | 3.7 | 4,916.3 | 4,916.3 | 4,916.3 | 0.0 |
| D | 1,654 | 172 | 77 | 2.3 | 4,921.1 | 4,921.1 | 4,921.1 | 0.0 |
| ¹ Feet above confluence with Flat Creek ² Floodway topwidth includes width of high ground | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | GOLF COURSE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|------------------|----------------------------|---------------------------------|--|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 2,216 | 58 | 27 | 4.1 | 4,750.8 | 4,750.8 | 4,750.8 | 0.0 |
| B | 2,782 | 121 ² | 85 | 1.3 | 4,755.8 | 4,755.8 | 4,755.8 | 0.0 |
| C | 3,105 | 121 ² | 308 | 0.4 | 4,755.9 | 4,755.9 | 4,755.9 | 0.0 |
| ¹ Feet above confluence with East Gallatin River ² Floodway topwidth influenced by Mill Ditch Diversion and Cedar Street Split | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | INTERSTATE 90 SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|--------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Jefferson River | | | | | | | | |
| AJ | 20,848 | 3,306 | 12,586 | 1.8 | 4,062.7 | 4,062.7 | 4,063.1 | 0.4 |
| BJ | 20,982 | 2,984 | 10,503 | 2.2 | 4,062.8 | 4,062.8 | 4,063.2 | 0.4 |
| CJ | 21,211 | 2,495 | 7,475 | 3.1 | 4,063.1 | 4,063.1 | 4,063.5 | 0.4 |
| DJ | 21,468 | 2,120 | 8,868 | 2.6 | 4,064.9 | 4,064.9 | 4,064.9 | 0.0 |
| EJ | 23,315 | 1,904 | 9,289 | 2.5 | 4,065.6 | 4,065.6 | 4,065.8 | 0.2 |
| FJ | 24,063 | 451 | 8,715 | 7.0 | 4,066.1 | 4,066.1 | 4,066.4 | 0.3 |
| GJ | 24,430 | 773 | 10,540 | 5.1 | 4,067.1 | 4,067.1 | 4,067.5 | 0.4 |
| HJ | 25,238 | 3,173 | 10,491 | 2.2 | 4,068.4 | 4,068.4 | 4,068.7 | 0.3 |
| IJ | 26,635 | 5,391 | 19,241 | 1.2 | 4,069.2 | 4,069.2 | 4,069.6 | 0.4 |
| JJ | 29,625 | 5,328 | 12,367 | 1.9 | 4,071.1 | 4,071.1 | 4,071.5 | 0.4 |
| KJ | 30,957 | 4,034 | 8,555 | 2.7 | 4,072.8 | 4,072.8 | 4,073.2 | 0.4 |
| LJ | 32,260 | 5,855 | 13,426 | 1.7 | 4,074.1 | 4,074.1 | 4,074.4 | 0.3 |
| MJ | 33,222 | 5,692 | 8,704 | 2.7 | 4,075.7 | 4,075.7 | 4,075.8 | 0.1 |
| NJ | 34,373 | 4,901 | 11,823 | 2.0 | 4,077.7 | 4,077.7 | 4,078.0 | 0.3 |
| OJ | 34,895 | 5,454 | 10,145 | 2.3 | 4,078.6 | 4,078.6 | 4,078.9 | 0.3 |
| PJ | 35,664 | 5,472 | 11,488 | 2.0 | 4,079.8 | 4,079.8 | 4,080.1 | 0.3 |
| QJ | 37,132 | 5,871 | 10,625 | 2.1 | 4,081.7 | 4,081.7 | 4,082.1 | 0.4 |
| RJ | 38,263 | 5,212 | 8,491 | 2.6 | 4,083.7 | 4,083.7 | 4,084.1 | 0.4 |
| SJ | 39,736 | 3,997 | 8,984 | 2.4 | 4,085.4 | 4,085.4 | 4,085.8 | 0.4 |
| TJ | 40,889 | 881 | 2,963 | 7.1 | 4,087.6 | 4,087.6 | 4,087.9 | 0.3 |
| UJ | 41,856 | 239 | 2,493 | 8.5 | 4,089.4 | 4,089.4 | 4,089.5 | 0.1 |
| VJ | 42,101 | 261 | 2,867 | 8.2 | 4,090.6 | 4,090.6 | 4,090.6 | 0.0 |

¹ Feet above confluence with Madison River

² Includes widths outside of county limits

TABLE 7

**FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS**

FLOODWAY DATA

JEFFERSON RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|--|---|------------------|----------------------------|---------------------------------|--|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 404 | 33 | 13 | 3.6 | 4,897.0 | 4,897.0 | 4,897.0 | 0.0 |
| B | 723 | 31 | 27 | 1.7 | 4,903.2 | 4,903.2 | 4,903.2 | 0.0 |
| C | 1,066 | 247 ² | 46 | 1.0 | 4,907.0 | 4,907.0 | 4,907.0 | 0.0 |
| ¹ Feet above confluence with Bozeman Creek ² Floodway topwidth includes width of high ground area | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | KAGY/ROUSE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 59 | 74 | 139 | 0.1 | 4,858.6 | 4,858.6 | 4,858.9 | 0.3 |
| B | 541 | 39 | 28 | 0.4 | 4,858.6 | 4,858.6 | 4,858.9 | 0.3 |
| C | 1,266 | 110 | 13 | 3.0 | 4,867.0 | 4,867.0 | 4,867.0 | 0.0 |
| ¹ Feet above confluence with Rouse Avenue Split ² Floodway not computed for this cross section | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | LOWER BLACK AVENUE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION | | | |
|------------------|-----------------------|-----------------|-------------------------------------|--|--|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| Madison River | | | | | | | | |
| AM | 13,668 | 2,430 | 4,039 | 2.5 | 4,058.7 | 4,055.4 | 4,055.7 | 0.3 |
| BM | 14,792 | 2,759 | 6,247 | 1.6 | 4,060.0 | 4,057.0 | 4,057.2 | 0.2 |
| CM | 16,027 | 1,870 | 4,345 | 2.3 | 4,062.7 | 4,059.3 | 4,059.8 | 0.4 |
| DM | 17,089 | 620 | 1,664 | 7.6 | 4,066.4 | 4,062.1 | 4,062.3 | 0.3 |
| EM | 17,322 | 540 | 3,399 | 3.8 | 4,067.6 | 4,064.3 | 4,064.8 | 0.4 |
| FM | 17,779 | 445 | 2,314 | 4.4 | 4,067.6 | 4,064.8 | 4,065.1 | 0.3 |
| GM | 17,940 | 360 | 1,552 | 9.4 | 4,067.7 | 4,064.6 | 4,065.0 | 0.3 |
| HM | 18,056 | 390 | 3,703 | 4.0 | 4,070.0 | 4,069.4 | 4,069.4 | 0.0 |
| IM | 18,259 | 235 | 2,146 | 4.7 | 4,070.3 | 4,069.4 | 4,069.8 | 0.3 |
| JM | 18,318 | 258 | 2,687 | 3.8 | 4,070.9 | 4,069.6 | 4,069.9 | 0.3 |
| KM | 18,680 | 910 | 7,440 | 1.4 | 4,072.1 | 4,069.9 | 4,070.2 | 0.3 |
| LM | 19,171 | 1,770 | 10,969 | 0.9 | 4,072.4 | 4,069.9 | 4,070.2 | 0.3 |
| MM | 20,054 | 1,050 | 4,365 | 2.3 | 4,073.0 | 4,070.1 | 4,070.5 | 0.4 |
| NM | 20,981 | 930 | 3,007 | 3.4 | 4,073.3 | 4,071.7 | 4,072.0 | 0.3 |
| OM | 21,659 | 861 | 2,839 | 3.6 | 4,077.3 | 4,073.8 | 4,074.1 | 0.3 |
| PM | 22,723 | 570 | 2,173 | 4.7 | 4,079.7 | 4,076.3 | 4,076.7 | 0.4 |
| QM | 24,115 | 1,302 | 4,672 | 2.2 | 4,081.8 | 4,078.9 | 4,079.4 | 0.5 |
| RM | 24,781 | 1,441 | 4,417 | 2.3 | 4,083.5 | 4,080.1 | 4,080.5 | 0.3 |

¹ Feet above confluence with Jefferson River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY
GALLATIN COUNTY, MT
AND INCORPORATED AREAS

FLOODWAY DATA

MADISON RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD) | | | |
|-----------------|-----------------------|-----------------|-------------------------------------|--|---|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 245 | 20 | 42 | 6.1 | 4,846.2 | 4,846.2 | 4,846.2 | 0.0 |
| B | 748 | 35 | 64 | 4.0 | 4,849.3 | 4,849.3 | 4,849.5 | 0.2 |
| C | 1,006 | 25 | 63 | 4.1 | 4,850.6 | 4,850.6 | 4,850.9 | 0.3 |
| D | 1,154 | 24 | 55 | 4.7 | 4,852.9 | 4,852.9 | 4,853.2 | 0.3 |
| E | 1,427 | 17 | 41 | 6.2 | 4,855.3 | 4,855.3 | 4,855.7 | 0.4 |
| F | 1,689 | 31 | 77 | 3.3 | 4,858.0 | 4,858.0 | 4,858.2 | 0.2 |
| G | 2,220 | 52 | 98 | 1.9 | 4,863.8 | 4,863.8 | 4,863.8 | 0.0 |
| H | 2,450 | 99 | 360 | 1.2 | 4,870.7 | 4,870.7 | 4,870.7 | 0.0 |
| I | 2,789 | 35 | 113 | 3.9 | 4,870.8 | 4,870.8 | 4,870.9 | 0.1 |
| J | 3,109 | 24 | 63 | 7.0 | 4,872.9 | 4,872.9 | 4,872.9 | 0.0 |
| K | 3,508 | 28 | 81 | 5.5 | 4,877.2 | 4,877.2 | 4,877.2 | 0.0 |
| L | 4,057 | 209 | 158 | 2.9 | 4,885.5 | 4,885.5 | 4,885.5 | 0.0 |
| M | 4,616 | 48 | 105 | 4.2 | 4,887.9 | 4,887.9 | 4,888.0 | 0.1 |
| N | 5,050 | 51 | 88 | 10.8 | 4,893.7 | 4,893.7 | 4,893.7 | 0.0 |
| O | 5,414 | 70 | 117 | 7.3 | 4,897.2 | 4,897.2 | 4,897.6 | 0.4 |
| P | 5,884 | 29 | 55 | 5.5 | 4,902.1 | 4,902.1 | 4,902.6 | 0.5 |
| Q | 6,151 | 37 | 71 | 4.2 | 4,905.1 | 4,905.1 | 4,905.5 | 0.4 |
| R | 6,419 | 36 | 65 | 4.7 | 4,907.2 | 4,907.2 | 4,907.6 | 0.4 |
| S | 6,639 | 44 | 85 | 3.6 | 4,909.8 | 4,909.8 | 4,910.3 | 0.5 |
| T | 7,017 | 37 | 75 | 4.0 | 4,913.7 | 4,913.7 | 4,914.1 | 0.4 |
| U | 7,448 | 18 | 44 | 6.9 | 4,917.3 | 4,917.3 | 4,917.4 | 0.1 |

¹ Feet above confluence with Bozeman Creek

| | | |
|---------|---|--------------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | MATHEW BIRD CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD) | | | |
|-----------------|-----------------------|-----------------|-------------------------------------|--|---|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| V | 7,918 | 107 | 145 | 3.6 | 4,924.2 | 4,924.2 | 4,924.2 | 0.0 |
| W | 8,422 | 135 | 181 | 1.7 | 4,927.9 | 4,927.9 | 4,928.3 | 0.4 |
| X | 8,835 | 67 | 68 | 4.5 | 4,931.4 | 4,931.4 | 4,931.7 | 0.3 |
| Y | 9,245 | 46 | 93 | 3.3 | 4,933.5 | 4,933.5 | 4,933.7 | 0.2 |
| Z | 9,834 | 57 | 98 | 3.1 | 4,936.5 | 4,936.5 | 4,936.8 | 0.3 |
| AA | 10,488 | 109 | 84 | 3.6 | 4,942.4 | 4,942.4 | 4,942.7 | 0.3 |
| AB | 11,080 | 59 | 109 | 2.7 | 4,949.3 | 4,949.3 | 4,949.8 | 0.5 |
| AC | 11,625 | 25 | 37 | 7.0 | 4,954.3 | 4,954.3 | 4,954.3 | 0.0 |
| AD | 11,952 | 45 | 96 | 2.7 | 4,958.5 | 4,958.5 | 4,958.9 | 0.4 |
| AE | 12,412 | 39 | 62 | 4.2 | 4,961.9 | 4,961.9 | 4,962.3 | 0.4 |
| AF | 12,924 | 42 | 81 | 3.2 | 4,968.3 | 4,968.3 | 4,968.7 | 0.4 |
| AG | 13,370 | 36 | 59 | 4.4 | 4,972.6 | 4,972.6 | 4,972.9 | 0.3 |
| AH | 13,851 | 90 ² | 111 | 2.3 | 4,977.9 | 4,977.9 | 4,978.4 | 0.5 |
| AI | 14,287 | 55 ² | 29 | 4.3 | 4,984.0 | 4,984.0 | 4,984.2 | 0.2 |
| AJ | 14,697 | 17 | 27 | 4.0 | 4,989.8 | 4,989.8 | 4,989.8 | 0.0 |
| AK | 15,481 | 27 | 32 | 5.4 | 5,000.3 | 5,000.3 | 5,000.3 | 0.0 |
| AL | 16,075 | 40 | 59 | 4.1 | 5,005.3 | 5,005.3 | 5,005.3 | 0.0 |
| AM | 16,362 | 27 | 59 | 4.1 | 5,011.4 | 5,011.4 | 5,011.6 | 0.2 |
| AN | 16,796 | 58 | 69 | 3.5 | 5,018.8 | 5,018.8 | 5,018.9 | 0.1 |
| AO | 17,289 | 56 | 52 | 4.6 | 5,025.4 | 5,025.4 | 5,025.4 | 0.0 |
| AP | 17,832 | 14 | 11 | 5.1 | 5,030.6 | 5,030.6 | 5,030.6 | 0.0 |

¹ Feet above confluence with Bozeman Creek

² Floodway topwidth includes width of high ground

| | | |
|---------|---|-------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | FLOODWAY DATA |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | MATHEW BIRD CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD) | | | |
|---|--|-----------------|-------------------------------------|--|---|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| AQ | 18,341 | 21 | 48 | 1.2 | 5,043.9 | 5,043.9 | 5,044.2 | 0.3 |
| AR | 18,720 | 33 | 78 | 0.7 | 5,048.5 | 5,048.5 | 5,048.7 | 0.2 |
| AS | 19,298 | 28 | 29 | 6.3 | 5,055.7 | 5,055.7 | 5,055.7 | 0.0 |
| AT | 19,639 | 301 | 172 | 1.4 | 5,062.1 | 5,062.1 | 5,062.1 | 0.0 |
| AU | 20,006 | 22 ² | 14 | 5.3 | 5,066.1 | 5,066.1 | 5,066.1 | 0.0 |
| AV | 20,778 | 17 | 21 | 2.7 | 5,075.1 | 5,075.1 | 5,075.4 | 0.3 |
| ¹ Feet above confluence with Bozeman Creek ² Floodway topwidth includes width of high ground | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | MATHEW BIRD CREEK | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD) | | | |
|-----------------|-----------------------|------------------|-------------------------------------|--|---|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 15 | 275 ² | 229 | 5.9 | 4,750.0 | 4,750.0 | 4,750.0 | 0.0 |
| B | 282 | 342 | 1,505 | 0.8 | 4,755.8 | 4,755.8 | 4,755.8 | 0.0 |
| C | 671 | 167 | 653 | 0.2 | 4,755.9 | 4,755.9 | 4,755.9 | 0.0 |
| D | 1,112 | 42 | 70 | 2.2 | 4,755.9 | 4,755.9 | 4,755.9 | 0.0 |
| E | 1,332 | 43 | 71 | 2.2 | 4,756.3 | 4,756.3 | 4,756.3 | 0.0 |
| F | 1,629 | 234 | 499 | 0.5 | 4,759.1 | 4,759.1 | 4,759.1 | 0.0 |
| G | 2,032 | 48 | 49 | 4.9 | 4,759.7 | 4,759.7 | 4,759.8 | 0.1 |
| H | 2,322 | 51 | 94 | 2.6 | 4,762.7 | 4,762.7 | 4,762.9 | 0.2 |
| I | 2,926 | 35 | 56 | 3.7 | 4,767.8 | 4,767.8 | 4,767.8 | 0.0 |
| J | 3,058 | 56 | 106 | 1.5 | 4,768.8 | 4,768.8 | 4,768.8 | 0.0 |
| K | 3,534 | 32 | 109 | 1.7 | 4,773.7 | 4,773.7 | 4,773.7 | 0.0 |
| L | 4,077 | 13 | 22 | 7.4 | 4,783.9 | 4,783.9 | 4,783.9 | 0.0 |
| M | 4,536 | 22 | 79 | 3.0 | 4,789.3 | 4,789.3 | 4,789.3 | 0.0 |
| N | 5,207 | 16 | 31 | 4.0 | 4,797.1 | 4,797.1 | 4,797.1 | 0.0 |
| O | 5,603 | 30 | 70 | 1.8 | 4,800.5 | 4,800.5 | 4,800.5 | 0.0 |
| P | 5,973 | 12 | 19 | 6.5 | 4,803.1 | 4,803.1 | 4,803.1 | 0.0 |
| Q | 6,497 | 23 | 51 | 2.4 | 4,809.1 | 4,809.1 | 4,809.1 | 0.0 |
| R | 6,915 | 10 | 20 | 6.0 | 4,814.1 | 4,814.1 | 4,814.2 | 0.1 |
| S | 8,158 | 16 | 22 | 5.7 | 4,830.1 | 4,830.1 | 4,830.1 | 0.0 |
| T | 8,476 | 38 | 63 | 2.2 | 4,835.4 | 4,835.4 | 4,835.4 | 0.0 |
| U | 8,938 | 56 | 84 | 1.5 | 4,838.1 | 4,838.1 | 4,838.1 | 0.0 |

¹ Feet above confluence with East Gallatin River

² Floodway topwidth influenced by East Gallatin River

| | | |
|---------|---|-----------------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | MILL DITCH DIVERSION |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD) | | | |
|---|--|-----------------|-------------------------------------|--|---|---------------------------------|------------------------------|--------------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 189 | 136 | 25 | 2.0 | 4,922.4 | 4,922.4 | 4,922.4 | 0.0 |
| B | 610 | 21 | 14 | 3.6 | 4,929.1 | 4,929.1 | 4,929.1 | 0.0 |
| C | 1,069 | 58 | 22 | 2.3 | 4,934.0 | 4,934.0 | 4,934.0 | 0.0 |
| D | 1,561 | 27 | 21 | 2.4 | 4,938.9 | 4,938.9 | 4,938.9 | 0.0 |
| ¹ Feet above confluence with Figgins Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | MUSEUM SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|--|---|------------------|----------------------------|---------------------------------|------------------------------------|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 161 | 137 | 114 | 2.0 | 5,152.6 | 5,152.6 | 5,152.8 | 0.2 |
| B | 934 | 52 | 65 | 3.4 | 5,163.1 | 5,163.1 | 5,163.5 | 0.4 |
| C | 1,417 | 651 ² | 968 | 0.2 | 5,169.9 | 5,169.9 | 5,169.9 | 0.0 |
| D | 1,882 | 545 ² | 41 | 6.4 | 5,173.2 | 5,173.2 | 5,173.2 | 0.0 |
| E | 2,373 | 440 ² | 196 | 2.6 | 5,179.2 | 5,179.2 | 5,179.2 | 0.0 |
| ¹ Feet above confluence with Bozeman Creek ² Floodway topwidth influenced by split from Bozeman Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | NASH ROAD SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 90 | 13 | 25 | 4.6 | 4,911.1 | 4,910.7 ⁵ | 4,910.7 ⁵ | 0.0 |
| B | 334 | 9 | 16 | 7.6 | 4,913.2 | 4,913.2 | 4,913.2 | 0.0 |
| C | 441 | 14 | 36 | 3.5 | 4,914.3 | 4,914.3 | 4,914.4 | 0.1 |
| D | 624 | 32 ² | 39 | 8.1 | 4,915.3 | 4,915.3 | 4,915.3 | 0.0 |
| E | 669 | 89 | 99 | 1.4 | 4,917.0 | 4,917.0 | 4,917.0 | 0.0 |
| F | 891 | 97 | 128 | 2.1 | 4,917.8 | 4,917.8 | 4,917.8 | 0.0 |
| G | 1,054 | 115 | 78 | 3.5 | 4,919.5 | 4,919.5 | 4,919.5 | 0.0 |
| H | 1,267 | 118 | 132 | 2.5 | 4,921.0 | 4,921.0 | 4,921.0 | 0.0 |
| I | 1,591 | 181 | 185 | 2.7 | 4,924.4 | 4,924.4 | 4,924.4 | 0.0 |
| J | 2,200 | 377 ³ | 238 | 2.1 | 4,928.3 | 4,928.3 | 4,928.4 | 0.1 |
| K | 2,288 | 278 ⁶ | 221 | 2.3 | 4,928.6 | 4,928.6 | 4,928.7 | 0.1 |
| L | 2,513 | 152 | 236 | 2.1 | 4,932.1 | 4,932.1 | 4,932.4 | 0.3 |
| M | 2,642 | 141 | 179 | 2.8 | 4,932.4 | 4,932.4 | 4,932.6 | 0.2 |
| N | 2,843 | 67 | 93 | 5.3 | 4,934.4 | 4,934.4 | 4,934.5 | 0.1 |
| O | 3,110 | 159 ³ | 185 | 2.7 | 4,935.8 | 4,935.8 | 4,936.3 | 0.5 |
| P | 3,392 | 153 ³ | 169 | 2.9 | 4,939.1 | 4,939.1 | 4,939.5 | 0.4 |
| Q | 3,451 | 102 ³ | 117 | 4.3 | 4,939.5 | 4,939.5 | 4,939.8 | 0.3 |
| R | 3,727 | 117 | 129 | 3.8 | 4,942.0 | 4,942.0 | 4,942.2 | 0.2 |
| S | 3,946 | 52 | 113 | 4.4 | 4,944.6 | 4,944.6 | 4,945.1 | 0.5 |
| T | 4,160 | 75 | 95 | 5.2 | 4,947.4 | 4,947.4 | 4,947.5 | 0.1 |
| U | 4,609 | 328 ³ | 404 | 2.3 | 4,952.1 | 4,952.1 | 4,952.1 | 0.0 |

¹ Feet above confluence with Bozeman Creek
² Floodway topwidth influenced by Golf Course Split
³ Floodway topwidth includes width of high ground area
⁴ Floodway topwidth influenced by split form Bozeman Creek
⁵ Without consideration of backwater effects

| | | |
|---------|--|-------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | NASH SPRING CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|-----------------|-----------------------|------------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| V | 4,996 | 22 | 36 | 6.3 | 4,955.2 | 4,955.3 | 4,955.3 | 0.0 |
| W | 5,544 | 65 ³ | 49 | 4.6 | 4,963.7 | 4,963.7 | 4,963.7 | 0.0 |
| X | 5,905 | 23 | 38 | 5.9 | 4,967.4 | 4,967.4 | 4,967.4 | 0.0 |
| Y | 6,297 | 21 | 42 | 5.8 | 4,972.8 | 4,972.8 | 4,972.8 | 0.0 |
| Z | 6,660 | 32 | 77 | 2.9 | 4,976.0 | 4,976.0 | 4,976.3 | 0.3 |
| AA | 7,005 | 54 ³ | 66 | 3.4 | 4,979.8 | 4,979.8 | 4,979.8 | 0.0 |
| AB | 7,266 | 56 | 75 | 3.0 | 4,982.0 | 4,982.0 | 4,982.2 | 0.2 |
| AC | 7,724 | 49 | 75 | 3.0 | 4,986.9 | 4,986.9 | 4,987.2 | 0.3 |
| AD | 8,626 | 30 | 58 | 3.9 | 4,994.0 | 4,994.0 | 4,994.3 | 0.3 |
| AE | 9,870 | 27 | 47 | 4.7 | 5,004.1 | 5,004.1 | 5,004.1 | 0.0 |
| AF | 10,392 | 21 | 52 | 4.3 | 5,011.7 | 5,011.7 | 5,012.1 | 0.4 |
| AG | 10,574 | 563 ⁴ | 559 | 0.4 | 5,017.3 | 5,017.3 | 5,017.3 | 0.0 |
| AH | 11,411 | 25 | 55 | 3.7 | 5,024.7 | 5,024.7 | 5,024.7 | 0.0 |
| AI | 12,287 | 25 | 49 | 4.2 | 5,033.9 | 5,033.9 | 5,033.9 | 0.0 |
| AJ | 13,259 | 30 | 37 | 5.6 | 5,045.3 | 5,045.3 | 5,045.3 | 0.0 |
| AK | 14,089 | 47 | 101 | 2.0 | 5,055.0 | 5,055.0 | 5,055.0 | 0.0 |

¹ Feet above confluence with Bozeman Creek
² Floodway topwidth influenced by Golf Course Split
³ Floodway topwidth includes width of high ground area
⁴ Floodway topwidth influenced by split form Bozeman Creek

| | | |
|---------|--|-------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | NASH SPRING CREEK |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 98 | 125 | 47 | 2.8 | 4,981.9 | 4,981.9 | 4,982.0 | 0.1 |
| B | 379 | 122 | 41 | 3.3 | 4,985.9 | 4,985.9 | 4,985.9 | 0.0 |
| C | 792 | 51 | 30 | 4.4 | 4,991.7 | 4,991.7 | 4,991.7 | 0.0 |
| D | 1,180 | 36 | 24 | 2.9 | 4,999.4 | 4,999.4 | 4,999.4 | 0.0 |
| ¹ Feet above confluence with Mathew Bird Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | RAIN ROPER SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 596 | 138 | 60 | 3.8 | 4,858.4 | 4,858.4 | 4,858.4 | 0.0 |
| B | 4,769 | 71 | 22 | 1.2 | 4,904.1 | 4,904.1 | 4,904.1 | 0.0 |
| ¹ Feet above confluence with Bozeman Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | ROUSE AVENUE SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|---|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 157 | 35 | 52 | 6.6 | 4,954.8 | 4,954.8 | 4,955.0 | 0.2 |
| B | 629 | 180 | 493 | 0.7 | 4,955.4 | 4,955.4 | 4,955.8 | 0.4 |
| C | 1,165 | 170 | 85 | 4.1 | 4,965.4 | 4,965.4 | 4,965.4 | 0.0 |
| D | 1,765 | 217 | 137 | 2.5 | 4,971.2 | 4,971.2 | 4,971.2 | 0.0 |
| ¹ Feet above confluence with Nash Spring Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | SOURDOUGH TRAIL SPLIT | | | | | |

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION (FEET) | | | |
|---|--|--------------|----------------------------|---------------------------------|---|---------------------------|------------------------|-----------------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY (NAVD88) | WITHOUT FLOODWAY (NAVD88) | WITH FLOODWAY (NAVD88) | INCREASE (FEET) |
| A | 572 | 60 | 35 | 4.3 | 4,890.9 | 4,890.9 | 4,890.9 | 0.0 |
| B | 840 | 61 | 35 | 4.3 | 4,897.8 | 4,897.8 | 4,897.8 | 0.0 |
| ¹ Feet above confluence with Mathew Bird Creek | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | | | | | |
| | GALLATIN COUNTY, MT AND INCORPORATED AREAS | | TRACY AVENUE SPLIT | | | | | |

| LOCATION | | FLOODWAY | | | 1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88) | | | |
|---------------------|-----------------------|-------------------|-------------------------|---------------------------|---|------------------|---------------|----------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/ SEC) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WEST GALLATIN RIVER | | | | | | | | |
| A | 386 | 895 ² | 2860 | 3.6 | 4163.1 | 4163.1 | 4163.2 | 0.1 |
| B | 1,806 | 800 | 2021 | 5.1 | 4166.9 | 4166.9 | 4167.4 | 0.5 |
| C | 3,583 | 871 ² | 2095 | 4.9 | 4174.4 | 4174.4 | 4174.7 | 0.3 |
| D | 5,474 | 840 ² | 2034 | 5.0 | 4180.3 | 4180.3 | 4180.6 | 0.3 |
| E | 7,427 | 632 ² | 1448 | 7.1 | 4187.3 | 4187.3 | 4187.5 | 0.2 |
| F | 8,999 | 779 | 2316 | 4.4 | 4193.4 | 4193.4 | 4193.5 | 0.1 |
| G | 10,924 | 1100 | 3063 | 3.3 | 4197.4 | 4197.4 | 4197.8 | 0.4 |
| H | 12,610 | 1146 ² | 2502 | 4.1 | 4203.1 | 4203.1 | 4203.4 | 0.3 |
| I | 14,595 | 1036 ² | 1793 | 5.7 | 4208.6 | 4208.6 | 4209.0 | 0.4 |
| J | 16,226 | 2168 ² | 2920 | 3.5 | 4214.9 | 4214.9 | 4215.3 | 0.4 |
| K | 18,192 | 3007 ² | 3109 | 3.3 | 4221.9 | 4221.9 | 4221.9 | 0.0 |
| L | 19,735 | 3961 ² | 4695 | 2.2 | 4224.8 | 4224.8 | 4225.1 | 0.3 |
| M | 21,689 | 2802 ² | 3593 | 2.9 | 4233.2 | 4233.2 | 4233.7 | 0.5 |
| N | 23,578 | 1151 ² | 1496 | 6.0 | 4241.4 | 4241.4 | 4241.8 | 0.4 |
| O | 25,158 | 985 ² | 2075 | 4.5 | 4248.5 | 4248.5 | 4248.9 | 0.4 |
| P | 26,546 | 825 ² | 2348 | 4.0 | 4252.4 | 4252.4 | 4252.7 | 0.3 |
| Q | 28,027 | 904 ² | 2425 | 3.9 | 4257.6 | 4257.6 | 4257.9 | 0.3 |
| R | 29,418 | 1362 ² | 2035 | 4.7 | 4263.3 | 4263.3 | 4263.6 | 0.3 |
| S | 31,197 | 1180 ² | 2237 | 4.3 | 4271.2 | 4271.2 | 4271.4 | 0.2 |
| T | 32,692 | 1054 | 1902 | 5.0 | 4278.0 | 4278.0 | 4278.4 | 0.4 |
| U | 34,255 | 880 | 2160 | 4.4 | 4284.4 | 4284.4 | 4284.6 | 0.2 |
| V | 35,735 | 1219 ² | 2328 | 4.1 | 4290.1 | 4290.1 | 4290.4 | 0.3 |

¹Feet above confluence with Gallatin River

²Floodway topwidth includes width of high ground area

| | | | | |
|---------|-------------------------------------|--|---------------------|--|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY | | FLOODWAY DATA | |
| | GALLATIN COUNTY, MT | | WEST GALLATIN RIVER | |
| | AND INCORPORATED AREAS | | | |

| LOCATION | | FLOODWAY | | | 1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88) | | | |
|---------------------|-----------------------|-------------------|-------------------------|---------------------------|---|------------------|---------------|----------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/ SEC) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WEST GALLATIN RIVER | | | | | | | | |
| W | 37,269 | 1113 ² | 2890 | 3.3 | 4296.8 | 4296.8 | 4297.3 | 0.5 |
| X | 39,078 | 797 | 2875 | 3.4 | 4306.4 | 4306.4 | 4306.4 | 0.0 |
| Y | 41,046 | 619 ² | 1511 | 6.5 | 4314.1 | 4314.1 | 4314.4 | 0.3 |
| Z | 42,840 | 1415 | 3552 | 2.8 | 4322.2 | 4322.2 | 4322.6 | 0.4 |
| AA | 44,544 | 1532 ² | 2084 | 4.7 | 4330.0 | 4330.0 | 4330.2 | 0.2 |
| AB | 46,521 | 1493 ² | 2435 | 4.0 | 4341.6 | 4341.6 | 4342.0 | 0.4 |
| AC | 48,420 | 998 ² | 1952 | 5.0 | 4350.9 | 4350.9 | 4351.3 | 0.4 |
| AD | 50,306 | 1045 ² | 2140 | 4.6 | 4361.5 | 4361.5 | 4361.7 | 0.2 |
| AF | 53,311 | 789 ² | 1800 | 5.4 | 4379.0 | 4379.0 | 4379.3 | 0.3 |
| AG | 54,714 | 821 ² | 1693 | 5.8 | 4387.6 | 4387.6 | 4388.0 | 0.4 |
| AH | 56,690 | 925 | 2353 | 4.2 | 4398.6 | 4398.6 | 4398.7 | 0.1 |
| AI | 58,576 | 802 ² | 1465 | 6.7 | 4410.3 | 4410.3 | 4410.5 | 0.2 |
| AJ | 60,169 | 749 ² | 1689 | 5.8 | 4417.2 | 4417.2 | 4417.6 | 0.4 |
| AK | 61,822 | 762 | 2695 | 3.6 | 4426.3 | 4426.3 | 4426.8 | 0.5 |
| AL | 63,676 | 1257 ² | 1923 | 5.1 | 4436.0 | 4436.0 | 4436.1 | 0.1 |
| AM | 65,418 | 726 ² | 1638 | 6.0 | 4447.6 | 4447.6 | 4447.8 | 0.2 |
| AN | 66,941 | 980 ² | 1346 | 7.3 | 4456.9 | 4456.9 | 4457.2 | 0.3 |
| AO | 68,881 | 1466 ² | 2096 | 4.7 | 4470.5 | 4470.5 | 4470.8 | 0.3 |
| AP | 70,411 | 1411 ² | 2205 | 4.5 | 4478.7 | 4478.7 | 4479.1 | 0.4 |
| AQ | 72,407 | 770 | 1701 | 5.8 | 4491.8 | 4491.8 | 4492.0 | 0.2 |
| AR | 73,955 | 769 ² | 1968 | 5.0 | 4499.9 | 4499.9 | 4500.0 | 0.1 |
| AS | 75,810 | 328 | 1445 | 6.8 | 4510.7 | 4510.7 | 4510.7 | 0.0 |

¹Feet above confluence with Gallatin River

²Floodway topwidth includes width of high ground area

| | | |
|---------|---|----------------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | WEST GALLATIN RIVER |

| LOCATION | | FLOODWAY | | | 1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88) | | | |
|---------------------|-----------------------|-------------------|-------------------------|---------------------------|---|------------------|---------------|----------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/ SEC) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WEST GALLATIN RIVER | | | | | | | | |
| AT | 77,398 | 804 ² | 2224 | 4.5 | 4520.2 | 4520.2 | 4520.4 | 0.2 |
| AU | 79,311 | 1020 ² | 2858 | 3.6 | 4532.2 | 4532.2 | 4532.5 | 0.3 |
| AV | 80,749 | 645 ² | 1434 | 7.2 | 4540.4 | 4540.4 | 4540.8 | 0.4 |
| AW | 81,668 | 744 ² | 1905 | 5.4 | 4546.2 | 4546.2 | 4546.3 | 0.1 |
| AX | 83,465 | 1402 ² | 2726 | 3.8 | 4556.1 | 4556.1 | 4556.3 | 0.2 |
| AY | 85,371 | 1267 ² | 2166 | 4.7 | 4568.0 | 4568.0 | 4568.2 | 0.2 |
| AZ | 86,918 | 1953 ² | 3130 | 3.3 | 4575.2 | 4575.2 | 4575.3 | 0.1 |
| BA | 88,554 | 1104 ² | 1851 | 5.6 | 4584.5 | 4584.5 | 4584.8 | 0.3 |
| BB | 90,470 | 782 ² | 1832 | 5.6 | 4596.6 | 4596.6 | 4596.6 | 0.0 |
| BC | 91,967 | 847 ² | 1627 | 6.3 | 4606.0 | 4606.0 | 4606.3 | 0.3 |
| BD | 93,515 | 1586 ² | 3325 | 3.1 | 4614.3 | 4614.3 | 4614.8 | 0.5 |
| BE | 95,229 | 914 ² | 1989 | 5.2 | 4624.4 | 4624.4 | 4624.6 | 0.2 |
| BF | 96,833 | 971 ² | 1912 | 5.4 | 4634.2 | 4634.2 | 4634.7 | 0.5 |
| BG | 98,375 | 1161 ² | 2438 | 4.2 | 4644.0 | 4644.0 | 4644.5 | 0.5 |
| BH | 100,132 | 1092 ² | 1920 | 5.4 | 4654.0 | 4654.0 | 4654.3 | 0.3 |
| BI | 101,481 | 1293 | 3555 | 2.9 | 4660.1 | 4660.1 | 4660.6 | 0.5 |
| BJ | 102,907 | 1356 ² | 3063 | 3.4 | 4668.9 | 4668.9 | 4669.3 | 0.4 |
| BK | 104,428 | 1113 ² | 2984 | 3.4 | 4679.1 | 4679.1 | 4679.6 | 0.5 |
| BL | 105,987 | 1177 ² | 2296 | 4.5 | 4688.8 | 4688.8 | 4689.2 | 0.4 |
| BM | 107,608 | 892 ² | 2736 | 3.9 | 4700.3 | 4700.3 | 4700.4 | 0.1 |
| BN | 109,498 | 871 ² | 1855 | 5.5 | 4710.3 | 4710.3 | 4710.6 | 0.3 |
| BO | 110,992 | 673 ² | 1596 | 6.4 | 4719.1 | 4719.1 | 4719.3 | 0.2 |

¹Feet above confluence with Gallatin River

²Floodway topwidth includes width of high ground area

| | | |
|---------|---|----------------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | FLOODWAY DATA |
| | | WEST GALLATIN RIVER |

| LOCATION | | FLOODWAY | | | 1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88) | | | |
|---------------------|-----------------------|-------------------|-------------------------------|---------------------------------|--|---------------------|------------------|----------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/ SEC) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WEST GALLATIN RIVER | | | | | | | | |
| BP | 112,560 | 481 ² | 1244 | 8.3 | 4728.4 | 4728.4 | 4728.5 | 0.1 |
| BQ | 114,490 | 1325 ² | 1615 | 6.4 | 4739.3 | 4739.3 | 4739.6 | 0.3 |
| BR | 116,442 | 779 ² | 1865 | 5.5 | 4751.8 | 4751.8 | 4752.2 | 0.4 |
| BS | 118,003 | 773 ² | 1736 | 5.9 | 4760.2 | 4760.2 | 4760.7 | 0.5 |
| BT | 119,971 | 744 ² | 1458 | 7.0 | 4772.1 | 4772.1 | 4772.1 | 0.0 |
| BU | 121,486 | 515 ² | 1511 | 6.8 | 4781.9 | 4781.9 | 4781.9 | 0.0 |
| BV | 122,958 | 440 | 1381 | 7.4 | 4790.5 | 4790.5 | 4790.6 | 0.1 |
| BW | 124,493 | 1154 ² | 2238 | 4.6 | 4799.9 | 4799.9 | 4800.2 | 0.3 |
| BX | 126,170 | 1425 ² | 2039 | 5.0 | 4810.5 | 4810.5 | 4810.9 | 0.4 |
| BY | 127,650 | 815 ² | 1589 | 6.5 | 4820.5 | 4820.5 | 4820.6 | 0.1 |
| BZ | 129,374 | 651 ² | 1587 | 6.5 | 4831.3 | 4831.3 | 4831.5 | 0.2 |
| CA | 131,189 | 754 ² | 1717 | 6.0 | 4842.5 | 4842.5 | 4843.0 | 0.5 |
| CB | 132,819 | 597 ² | 1435 | 7.2 | 4853.4 | 4853.4 | 4853.8 | 0.4 |
| CC | 134,444 | 590 ² | 1498 | 6.9 | 4863.9 | 4863.9 | 4864.0 | 0.1 |
| CD | 136,275 | 734 ² | 2254 | 4.6 | 4875.5 | 4875.5 | 4875.9 | 0.4 |
| CE | 137,811 | 225 ² | 1117 | 9.2 | 4885.1 | 4885.1 | 4885.1 | 0.0 |
| CF | 138,953 | 1226 ² | 2054 | 5.0 | 4893.7 | 4893.7 | 4893.8 | 0.1 |
| CG | 140,525 | 1330 ² | 3114 | 3.3 | 4905.0 | 4905.0 | 4905.2 | 0.2 |
| CH | 142,333 | 1982 ² | 2500 | 4.1 | 4918.3 | 4918.3 | 4918.3 | 0.0 |
| CI | 144,328 | 1751 ² | 2233 | 4.6 | 4929.4 | 4929.4 | 4929.8 | 0.4 |
| CJ | 145,975 | 1396 ² | 1861 | 5.5 | 4939.4 | 4939.4 | 4939.9 | 0.5 |
| CK | 147,922 | 1030 ² | 1202 | 8.5 | 4953.1 | 4953.1 | 4953.2 | 0.1 |

¹Feet above confluence with Gallatin River

²Floodway topwidth includes width of high ground area

| | | | |
|---------|--|--|---------------------|
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | | FLOODWAY DATA |
| | | | WEST GALLATIN RIVER |

| LOCATION | | FLOODWAY | | | 1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88) | | | |
|---|--|-------------------|-------------------------|---------------------------|---|------------------|---------------|----------|
| CROSS SECTION | DISTANCE ¹ | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/ SEC) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WEST GALLATIN RIVER | | | | | | | | |
| CL | 149,498 | 1192 ² | 1882 | 5.5 | 4962.8 | 4962.8 | 4963.3 | 0.5 |
| CM | 151,381 | 1419 ² | 2057 | 5.0 | 4975.7 | 4975.7 | 4976.2 | 0.5 |
| CN | 153,339 | 714 ² | 1511 | 6.8 | 4987.5 | 4987.5 | 4987.7 | 0.2 |
| CO | 155,314 | 378 ² | 1388 | 7.4 | 5001.0 | 5001.0 | 5001.1 | 0.1 |
| CP | 157,250 | 729 ² | 1344 | 7.6 | 5013.8 | 5013.8 | 5014.0 | 0.2 |
| CQ | 159,075 | 324 | 1325 | 7.8 | 5025.1 | 5025.1 | 5025.4 | 0.3 |
| CR | 160,959 | 445 | 2125 | 4.8 | 5037.3 | 5037.3 | 5037.7 | 0.4 |
| CS | 163,181 | 200 ² | 1134 | 9.1 | 5049.3 | 5049.3 | 5049.7 | 0.4 |
| ¹ Feet above confluence with Gallatin River ² Floodway topwidth includes width of high ground area | | | | | | | | |
| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY GALLATIN COUNTY, MT AND INCORPORATED AREAS | | | | FLOODWAY DATA | | | |
| | | | | | WEST GALLATIN RIVER | | | |